US Army Corps
of Engineers
Walla Walla District

Jackson Hole, Wyoming Environmental Restoration Project

Environmental Assessment

March 1999

DEPARTMENT OF THE ARMY
WALLA WALLA DISTRICT, CORPS OF ENGINEERS
201 NORTH THIRD AVENUE
WALLA WALLA, WASHINGTON 99362-1876

REPLY TO
ATTENTION OF:

March 5, 1999

Planning Division

Dear Interested Party:

Enclosed for your review and comment are the Environmental Assessment (EA), Section 404(b)(l) Evaluation, and draft Finding of No Significant Impact (FONSI) for the proposed Jackson Hole, Wyoming, Environmental Restoration Project. These documents describe the effects of restoring riverine, wetland, and riparian habitats in four areas on the Snake River, near Jackson, Wyoming. The purpose of this project is to restore fish and wildlife habitat lost as a result of construction, operation, and maintenance of levees constructed under the Jackson Hole Flood Control Project, including levees constructed by non-Federal interests.

This letter serves as Public Notice Number CENWW-PD-EC 99-01. The Walla Walla District Corps of Engineers is requesting water quality certification from Wyoming Department of Environmental Quality (Wyoming DEQ) as per Section 401 of the Clean Water Act of 1977.

We invite interested parties to provide comments on the proposed project. Please provide your comments to:

Walla Walla District Corps of Engineers
Environmental Compliance Branch
ATTN: James S. Smith
201 N. 3rd Avenue
Walla Walla, Washington 99362-1876

Comments on the EA should be postmarked no later than April 6, 1999, to ensure consideration.

A public meeting will also be held to provide opportunity for interested parties to ask questions and provide comments on the proposed project. The meeting will be held March 24, 1999, from 4:00 p.m. until 7:00 p.m. at the Teton County Commissioner Chambers, 200 South Willow Street. Teton County Office Building, Jackson, Wyoming. The meeting will open with a general overview of the proposed project, after which, breakout sessions will be conducted to allow the Corps to receive input and answer questions.

Should you need additional information or have any questions, please contact Mr. James S. Smith at 509-527-7244.

Sincerely,

Peter F. Poolman

Peter F. Poolman
Chief, Environmental Compliance Branch

DRAFT
FINDING OF NO SIGNIFICANT IMPACT

JACKSON HOLE, WYOMING, ENVIRONMENTAL RESTORATION

The U.S. Army Corps of Engineers (Corps), Walla Walla District, proposes to construct channel stabilization pools, off-channel pools, secondary channels, eco fences, spur dikes, rock grade control structures, place root wad logs, and remove gravel for environmental restoration in the Snake River at Jackson, Wyoming. The purpose of the project is to restore fish and wildlife habitat that was lost as a result of the construction, operation, and maintenance of levees constructed under the Jackson Hole Flood Control Project (Public Law 516, Flood Control Act of 1950), including levees constructed by non-Federal interests (Water Resources Development Act of 1986).

The U.S. Senate Committee on Environment and Public Works authorized in a Study Resolution of June 12, 1990, the Jackson Hole, River and Wetland Restoration Study, Wyoming, to determine the advisability of restoring fish and wildlife habitat. The levees reduced the available floodplain resulting in increased water velocities, unstable channel configurations, elimination of natural channel braiding, and erosion of islands and associated vegetation. Snake River fine-spotted cutthroat trout habitat has been and continues to be affected through the loss of spawning areas. Spawning areas in the main river are reduced through scouring and in-spring creeks due to debris blockages. Other habitat impacts for fish include the loss of shade, in-stream woody debris, and loss of low-energy resting habitat. Terrestrial habitat has also been affected through the loss of shrub-willow and cottonwood riparian areas used by moose, elk, mule deer, furbearers, numerous small mammals, and various other wildlife species.

The Corps prepared an Environmental Assessment (EA) to evaluate the potential effects of restoration measures upon environmental resources and upon the Jackson Hole Flood Control Project. The purpose of the EA is to ensure actions and restoration measures proposed as a result of the study meet the requirements of the National Environmental Policy Act of 1969 and subsequent implementing regulations issued by the Council on Environmental Quality (40 CFR 15000) and the Corps ER 200-2-2. In the EA, the Corps considered four alternatives, including the no action alternative.

The Corps evaluated the no action alternative and determined the progressive loss of portions of the remaining aquatic and terrestrial habitat between the levees would continue. The “no action” alternative would not meet the purpose of the project or satisfy the need to prevent further loss of aquatic and terrestrial habitat and restore portions of habitat already lost. For these reasons, the Corps eliminated the no action alternative from further consideration.

The Corps identified and evaluated three other alternatives for implementation of restoration measures. One alternative included the implementation of restoration measures throughout the 500-year floodplain at an unlimited number of areas. This alternative took a very broad approach to restoring aquatic and terrestrial habitat that would implement measures between the levees, restore flows to spring creeks and vegetation outside of the levees, as well as maintain the base flood capacity. This comprehensive approach satisfied the purpose and need of the project; however, it proved to exceed the practical area and is far too costly for the local sponsor, therefore, was eliminated from further consideration.

A second alternative was developed to provide a similar comprehensive approach to restoring aquatic and terrestrial habitat and maintaining base flood capacity inside the existing levee system; however, 12 specific areas were identified for implementation of restoration measures. This alternative also satisfied the project purpose and need, but it too proved to exceed the practical area and was outside of the local sponsor’s fiscal ability. This alternative was also eliminated from further consideration.

A third alternative involved reducing the 12 specific sites to 4 specific sites that would have the greatest potential for restoring lost aquatic and terrestrial habitat and maintaining base flood capacity. To arrive at the four sites, the Corps conducted a multiple objective analysis. The analysis evaluated the areas on a number of elements including institutional recognition (national laws and regulations specific to the area), public recognition (environmental and economic value), and technical recognition (importance of spring creeks, spawning habitat, and eagle nesting). Additional analysis included the potential for channel creation for fisheries restoration, riparian island preservation and restoration, fish habitat creation, and spring creek restoration. It also included specific input from the scoping process, local input, and considerations of property ownership and cultural resources. Because this alternative would satisfy the project purpose and need and be within the local sponsor’s fiscal ability, the Corps selected it as the preferred alternative.

I have taken into consideration the technical aspects of the project, best scientific information available, public comment, and determinations of the EA. Based on this information, I have determined that the proposed action would not significantly affect the quality of the human environment, and that an Environmental Impact Statement is not required.

DATE: __________

____
William H. Bulen, Jr.
Lieutenant Colonel, Corps of Engineers,
District Engineer

JACKSON HOLE, WYOMING, ENVIRONMENTAL
RESTORATION PROJECT
ENVIRONMENTAL ASSESSMENT

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

APPENDIXES

PLATES

FIGURES

TABLES

PHOTOGRAPHS

GLOSSARY OF TERMS

Bank Barb: Rigid, riprap structure projecting into the current from the bankline. Its function is to deflect the current away from the bank, trap sand, provide flow diversity, and resting places for fish and other aquatic organisms. Dimensions vary, and the typical length averages 26 feet.

Channel Capacity Excavation: The excavation of riverbed cobble and gravel to increase flow capacity of the channel. Channel capacity excavations compensate for decreases in channel capacity resulting from deposition of bedload material and sediments and constricts flow to reduce erosion of point bars and islands.

Channel Stabilization Pool: See definition of sediment trap.

Eco Fence: A structure designed to trap and retain floating woody debris. Two types are referenced in the Environmental Assessment: Rock Eco Fence and Piling Eco Fence. The fences are employed to reduce erosion and to promote deposition. Flow velocities are reduced immediately downstream of fences, causing deposition of sediments. Deposited sediments facilitate bar/island formation and provide opportunity for establishment of vegetation. Fences also prevent erosion of existing bars/islands located immediately downstream.

Hack Sites: Acclimation area for raptors being reintroduced to the region.

Kicker: Same as a bank barb, except the kicker has a gravel and cobble core and a typical length averages 56 feet.

Off-Channel Pool: A pool constructed adjacent to the main channel. This serves as overwintering and rearing habitat for juvenile Snake River fine-spotted cutthroat trout and is used as a resting area by waterfowl.

Ordinary High Water Mark (OHWM): This is the general average elevation of annual ordinary high flows for a particular waterway. A line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank; shelving; changes in the character of soil; destruction of terrestrial vegetation; the presence of litter and debris; or other appropriate physical characteristics

Palustrine Scrub-Shrub (PSS): A class of wetland dominated by woody vegetation less than 20 feet tall. Includes true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. It is a successional stage of vegetation often leading to forested wetlands on river floodplains as islands.

Palustrine Forest (PF): A class of wetland characterized by woody vegetation that is 20 feet tall or taller.

GLOSSARY OF TERMS (Continued)

Piling Eco Fence: An eco fence constructed of driven steel piles with inter-connecting cables.   See definition of eco fence.

Rock Eco Fence: An eco fence constructed of riprap. See definition of eco fence.

Rock Grade Control: A layer of riprap forming a weir to prevent erosion or down-cutting of channel.

Root Wad Log: A tree trunk with a root wad attached. It is anchored in cobble to provide in-stream woody debris and promote sediment deposition.

Secondary Channel: A channel constructed adjacent to the main channel to transport flow to and from off-channel pools.

Sediment Trap: The excavation of riverbed cobble and gravel to create area of low-velocity flow so that bedload material drops out of the flow and is not transported further downstream.

Side Pool: See definition of off-channel pool.

Spur Dike: Spur dike usually refers to a single structure. However, as used in this environmental assessment the term represents a series or grouping of multiple bank barbs or kickers (as shown on the plates contained within this document).

Staging Area: Area for storage and dispensing of equipment fuels and lubricants. Also an area for equipment storage overnight or during nonuse.

Supply Channel: See definition of secondary channel.

ACRONYMS AND ABBREVIATIONS

BA	Biological Assessment
BLM	Bureau of Land Management
CAR	Coordination Act Report
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	Cubic feet per second
Corps	U.S. Army Corps of Engineers
DEQ	Department of Environmental Quality
EIS	Environmental Impact Statement
FIS	Flood Insurance Study
FONSI	Finding of No Significant Impact
HEC	Hydrological Emergency Center
HEP	Habitat Evaluation Procedure
HSI	Habitat Suitability Index
kaf	1,000 acre-feet
NEPA	National Environmental Policy Act
OHWM	Ordinary High Water Mark
PF	Palustrine Forest
PSS	Palustrine Scrub-Shrub
SHPO	State Historic Preservation Office
USGS	U.S. Geological Service
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
WGFD	Wyoming Game and Fish Department
WYNDD	Wyoming Natural Diversity Database

JACKSON HOLE, WYOMING, ENVIRONMENTAL RESTORATION PROJECT ENVIRONMENTAL ASSESSMENT

1.0 INTRODUCTION

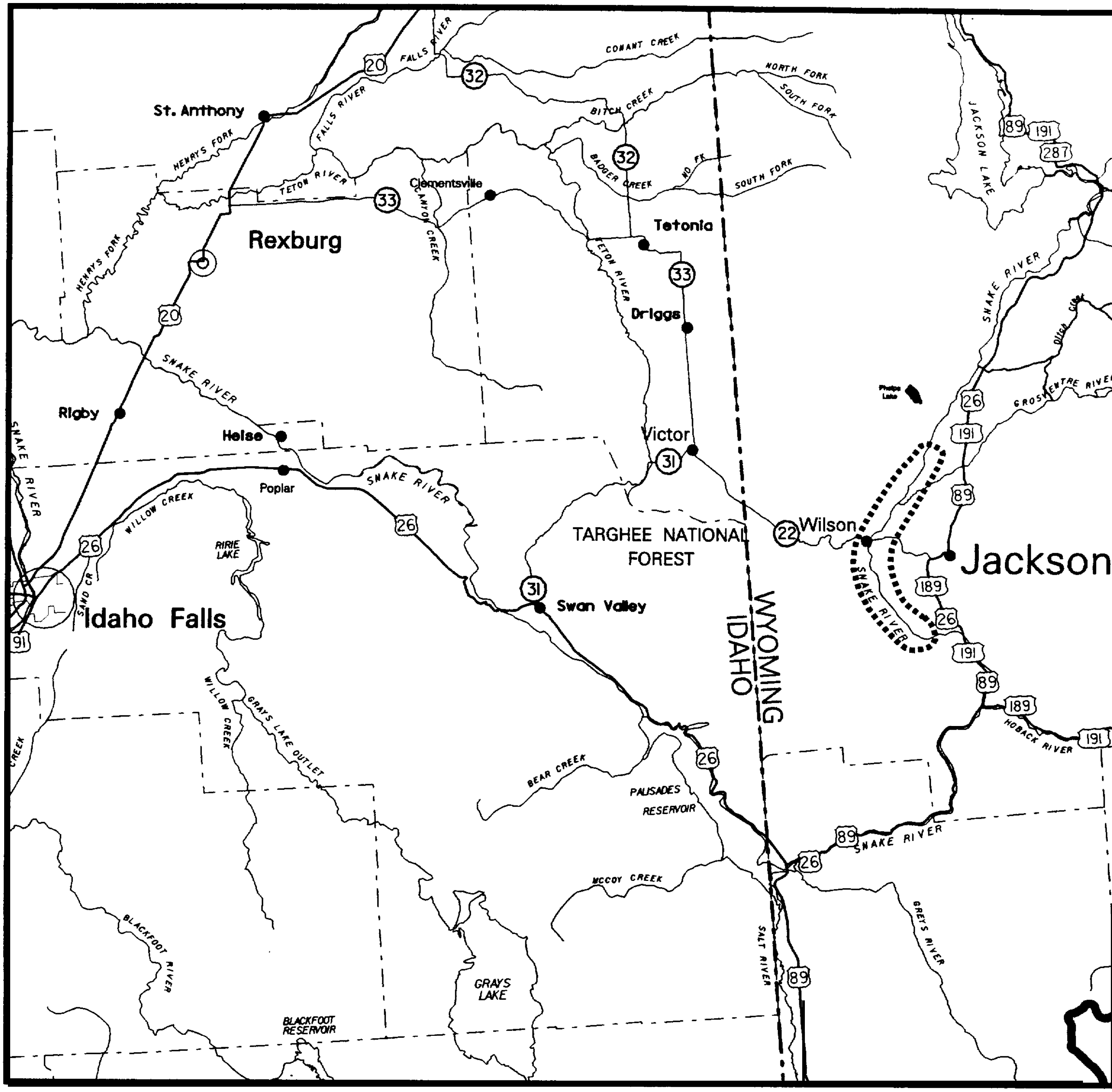
This environmental assessment (EA) considers the effects of restoring wetland and riparian habitats in the Snake River, between Grand Teton National Park and South Park Elk Feed Grounds near Jackson, Wyoming (figure 1-1 and plate 1). The proposed Jackson Hole, Wyoming, Environmental Restoration Project would involve channel stabilization measures to protect and increase fisheries habitat, island protection measures to preserve riparian island values, island environmental restoration measures to restore lost riparian values, and stream structure alteration to create fish habitat. The environmental restoration project is proposed in response to environmental resource impacts resulting from levees constructed under the Jackson Hole Flood Control Project.

The Jackson Hole Flood Control Project was authorized in the Flood Control Act of 1950, and provided flood protection by levees and revetment along the Snake River in Jackson Hole, Wyoming. The Jackson Hole Flood Control Project was completed in the fall of 1964, and the sponsor was Teton County. Additional levees were added to the system by other agencies and by "emergency flood fight" operations of the U.S. Army Corps of Engineers (Corps) and Teton County through 1997.

Authority to operate and maintain the Jackson Hole Flood Control Project was granted by Section 840 of the Water Resources Development Act of 1986 (Public Law 99-662) to the Secretary of the Army, including additions and modifications constructed by non-Federal sponsors, provided that the local sponsor provides the first $35,000 in any one year (adjusted for inflation). The Corps signed a Local Cooperative Agreement with Teton County in September 1990, after completion of a Decision Document and Environmental Impact Statement (EIS). The Corps assumed operation and maintenance responsibility for the levee system on the Snake and Gros Ventre Rivers in Jackson Hole, Wyoming.

The Jackson Hole, River and Wetland Restoration Study, Wyoming, was authorized by the U.S. Senate Committee on Environment and Public Works in a Study Resolution of June 12, 1990. The scope of the study was to determine the feasibility of providing environmental restoration to wetland and riparian habitats located between the flood control levees. Teton County, the local sponsor for the proposed environmental restoration project by the Corps, would provide funds in accordance with cost sharing requirements specified in Public Law 99-662, as amended.

As required by the National Environmental Policy Act (NEPA) of 1969 and subsequent implementing regulations promulgated by the Council on Environmental Quality (CEQ), this EA was prepared to determine whether the proposed environmental restoration project constitutes a “...major Federal action significantly affecting the quality of the human environment...” and whether an EIS is required.



PROJECT LOCATION

Geographic Information Systems
Corps of Engineers
Walla Walla District

Walla Walla District

Jackson Hole, Wyoming Environmental Restoration Project

VICINITY MAP

GIS Applications Coordinator: Blaise Grden (CENWW-PD-EC-AT) GIS Analyst & Graphic Assembly: Bridgett Reed (Anason Corp.)

PLOTTED: 03-MAR-1999 13:34
GIS FILE: g:\jacksonhole\jhl\work\plan\jers98\erjhl011.dg

Figure 1

2.0 PROJECT PURPOSE AND NEED

The purpose of this environmental restoration project is to restore fish and wildlife habitat that was lost as a result of construction, operation, and maintenance of levees constructed under the Jackson Hole Flood Control Project, including levees constructed by non-Federal interests. The project is located in the Snake River, near Jackson, Teton County, Wyoming.

While the levees have contributed significantly toward reducing flood damage potential along the river corridor, over time the levees have significantly changed the physical character of the river system and contributed to the loss of environmental resources. This environmental restoration project is needed to prevent further degradation and destruction of environmental resources within the study area and to facilitate recovery of lost aquatic and terrestrial habitat. The project has high potential for restoring fish and wildlife habitat through enhancement and restoration of the aquatic and terrestrial environment, including wetland and riparian vegetation and in-stream fisheries habitat.

3.0 EXISTING CONDITION

Flow velocities in both the main channels and the secondary channels tend to be high, due to the general steepness of the valley. Due to the high transport of bedload, the channel bed complex is constantly changing. During high flows, avulsion of the main channel into side channels is common. When the flow erodes a gravel bar or the main channel becomes clogged with debris, the flow can shift direction suddenly and unpredictably. However, construction of the Federal and non-Federal levees along the Snake River blocked the lateral spread of the river and reduced the width of the floodplain and the degree of randomness of the braided system. This limited the ability of the channel to migrate and restricted avulsion activity to the area between the levees, concentrating flows in the existing main channels and increasing the frequency of attack on islands and vegetation between the levees. The flow concentration and increased frequency of attack is preventing the natural recovery of islands and vegetation. Bedload materials, brought into suspension by the turbulent flow, are more likely to be carried through the system rather than being carried laterally into the slower secondary channels where they could be redeposited over a wider area of the floodplain.

Flood damages include loss of land due to bank erosion, loss of shrub-willow and mature cottonwoods, and damage to levees due to erosion or undercutting.

The quantity of riparian habitat, within the levees, has decreased from 2,761 acres in 1956 to 1,176 acres in 1986. The quality of the remaining riparian habitat has also declined (Corps 1998). The area of cottonwood forest behind the levees remained approximately constant between 1956 and 1986, but the quality of this habitat has been reduced. The percent of mature cottonwoods has increased behind the levees, indicating that cottonwood regeneration has declined. There was a 149 percent increase of cottonwood-spruce habitat from 1956 to 1986 behind the levees, indicating a loss of riparian habitat. The loss has been compounded by the side channels and spring creek habitats being cutoff from the river by the levees (Corps 1998).

The Snake River, in part of the area of the proposed action, is designated a Class 1 trout fishery by the Wyoming Game and Fish Department (WGFD). This designation signifies the river is of national importance as a trout fishery. This fishery is composed primarily of Snake River fine-spotted cutthroat trout (cutthroat trout) (*Oncorhynchus chlarki* spp). Numerous other game fish and non-game fish are present [U.S. Fish and Wildlife Service (USFWS) 1990]. Spawning habitat for the cutthroat trout is considered one of the major factors limiting population for this species in the upper Snake River drainage. Little or no spawning habitat exists in the main river because high flows, particularly during spring runoff, produce large sediment bedloads and turbidity during the spawning period. Spawning habitat losses have occurred from human activities, including diversions for irrigation and levee construction (USFWS 1990).

A variety of wildlife species, which use the Snake River in the environmental restoration project area, are affected by declines in wetland and riparian vegetation, including shrub-willow and cottonwood. Bald eagles (listed threatened by the USFWS) actively nest in close proximity to the project area. Bald eagles commonly use the snags (woody debris) and large living trees along the river for nesting and roosting (Corps 1994). Peregrine falcons often forage within the project areas. This species is presently classified as endangered by the USFWS and as Native Species Status 3 by the State of Wyoming due to restricted habitat availability and declining populations. Resident and migratory waterfowl use the Snake River and its tributaries for spring and fall staging, breeding, nesting, brood rearing, and wintering habitat (USFWS 1990). A large variety of other wildlife species use the aquatic and terrestrial habitat in the project area including trumpeter swans, whooping cranes (listed as endangered by USFWS), moose, elk, mule deer, various fur bearers, and numerous small mammals.

4.0 FOUR ALTERNATIVES CONSIDERED

4.1 ALTERNATIVE 1—MULTIPLE AREA RESTORATION WITHIN 500-YEAR FLOODPLAIN

This alternative would involve studying and implementing a combination of environmental restoration measures at an unlimited number of areas throughout the entire 500-year floodplain of the Snake River from Moose to South Park Elk Feed Grounds, Wyoming, approximately 25 miles. Measures would be implemented, in a manner that would not reduce the base flood capacity, along non-leveed stretches, as well as leveed stretches, including areas between and outside of the levees.

The Corps identified a set of environmental restoration tools or measures best suited for the conditions occurring throughout the 500-year floodplain. These included: gravel removal; channel stabilization pools; secondary channels leading to and from off-channel pools; off-channel pools; spur dikes (bank barbs and kickers); eco fences (both rock and piling fences); anchored root wad logs; rock grade control structures; and head gates. Refer to paragraph 5.1 for a listing of the proposed tools. Spur dikes, eco fences, anchored root wad logs, and rock grade control structures would be designed to have multiple strengths based on the use of alternative materials. Material selection would be based on the level of strength determined appropriate to withstand 3 levels of major flow events: 15, 25, and 50 years. Table 4-1 provides a breakdown of the alternative materials that would provide different strengths for these structures. Rock gradations referenced in table 4-1 are based on minimum and maximum rock size for each gradation, ranging from the smallest for gradation 1 to the largest for gradation 4. When complete, the cost-benefit analysis being prepared (as part of the Feasibility Study for this environmental restoration project) will compare the cost of constructing tools of various strengths to the aquatic and terrestrial habitat benefits that may reasonably be expected to accrue for each level of tool strength. The results of the analysis would be used in selecting material strength or level of protection.

A plan for studying the feasibility of implementing this alternative was prepared and submitted to the local sponsor. The plan exceeded the practical acreage and the local sponsor rejected the plan due to cost, therefore, this alternative was eliminated from further consideration.

4.2 ALTERNATIVE 2—RESTORATION AT 12 AREAS WITHIN 500-YEAR FLOODPLAIN

This alternative is based on reduction of the “Alternative 1—Multiple Area Restoration Within 500-year Floodplain” to 12 specific areas. The same environmental restoration tools, as Alternative 1, would be implemented within these 12 areas, with the exception of head gates, which were eliminated from the range of tools due to expense. A plan for studying the feasibility of implementing this alternative, consistent with the environmental restoration project’s purpose and need, was prepared and submitted to the local sponsor. The cost of the study was significantly reduced, however, it was eliminated from further consideration because the magnitude and the acreage of this alternative was impractical at this time and the local sponsor rejected the plan.

4.3 ALTERNATIVE 3—RESTORATION AT FOUR AREAS WITHIN 500-YEAR FLOODPLAIN

This alternative is based on reducing "Alternative 2—Restoration at 12 areas within 500-Year Floodplain" to 4 specific areas (refer to section 5.0 for a description of areas) that provide the best opportunity for restoration of aquatic and terrestrial habitat. To determine the 4 most suitable sites, the 12 sites were evaluated on the basis of their institutional recognition (national laws and regulations specific to the area); public recognition (environmental and economic value); and technical recognition (importance of spring creeks, spawning habitat, and eagle nesting). Additional analysis included the potential for channel creation for fisheries restoration, riparian island preservation and restoration, fish habitat creation, and spring creek restoration. This multiple objective analysis (along with specific input from the scoping process, local input and considerations of property ownership, and cultural resources) served as the basis for selecting the four areas. Further discussion of evaluation criteria used in selecting the four sites may be found in the Jackson Hole, Wyoming, Environmental Restoration, Project Study Plan, July 1996. This alternative was determined to be financially feasible for the local sponsor and would still provide aquatic and terrestrial habitat benefits consistent with the environmental restoration project's purpose and need.

4.4 ALTERNATIVE 4—NO ACTION

If no environmental restoration measures are instituted, the main channel of the Snake River would continue to shift back and forth between the levees in a random manner. Based on current trends, much of the remaining mid-channel stands of mature trees would be washed away in Areas 9 and 10. Because the river does not occupy the entire area between the levees, there would be some recovery, particularly in the wider portions of the channel. Some damaged areas of the channel, over time, have recovered long enough to develop a 10- to 20-year growth. However, it does not appear that the river is stable enough to allow any significant areas to remain undisturbed long enough for a 50-year growth to occur. The leveed reach has experienced a net loss of bedload material. However, the rate of loss appears to be decreasing with time. Erosion and reworking of the channel bed gravel would continue in the future, but at a gradually decreasing rate. The continual reworking of the channel bed gravel would result in a progressive loss of fine material, which supports vegetation. Recovery of damaged areas would be slower and larger areas of the channel bed would remain relatively vegetation free.

Areas 1 and 4 are likely to retain a more natural, random distribution of vegetation than Areas 9 and 10 since there is more space for lateral channel movement.

Gravel transport and deposition in Areas 1 and 4 were probably the highest just after completion of the levees and has decreased (on the average) since then. For this reason, it is likely that most of the damage resulting from excess gravel inflow has already occurred. It is not likely that the gross area of denuded gravel beds would increase in these two areas. However, the continued inflow and deposition of gravel is likely to keep the channel unstable (particularly in Area 4 at the downstream end of the Federal Levee Project). The channel in this area is likely to continue shifting to one side or the other, attacking new undisturbed banklines on the margins of the meander belt, frequently damaging vegetation, and preventing the establishment of mature stands of cottonwood and willow. Based on these observed general trends, if no action is taken, the physical character of the river system would continue to experience similar changes. These changes would reasonably result in the progressive loss of portions of the remaining aquatic and terrestrial habitat and interfere with the development of mature stands of cottonwood and willow. Recovery of impacted areas would generally continue to be limited by the shifting, unstable nature of the channel. Overall, a general decrease in the amount of aquatic and terrestrial habitat would continue.

Table 4-1. Optional Structure Strengths for 15-, 25-, and 50-Year Major Flow Events.

Level of Protection	Piling Eco Fence	Rock Eco Fence	Bank Barb	Kicker	Anchored Root Wad Log	Rock Grade Control
15 years	6-inch pipe casing	No Alternative	Rock Gradation 1	No Alternative	1/4-inch cable	Rock Gradation 1
25 years	8-inch pipe casing	No Alternative	Rock Gradation 2	No Alternative	1/4-inch cable	Rock Gradation 2
50 years	10-inch pipe casing	No Alternative	Rock Gradation 3	No Alternative	5/16-inch cable	Rock Gradation 3
50 years	No Alternative	Rock Gradation 4	No Alternative	Rock Gradation 4	5/16-inch cable	Rock Gradation 4

5.0 PREFERRED ALTERNATIVE

"Alternative 3-Restoration at Four Areas Within the 500-Year Floodplain" was selected as the preferred alternative. The four selected sites in Teton County, Wyoming, are identified as Areas 1, 4, 9, and 10, as depicted on plates 2, 3, 4, and 5, respectively. Area 1 is located in sections 13, 14, 23, and 24, Township 40 N., Range 117 W.; Area 4 is located in sections 2, 3, 10, and 11, Township 40 N., Range 117 W.; Area 9 is located in sections 13, and 24, Township 41 N., Range 117 W.; and Area 10 is located in sections 5, 6, and 7, Township 41 N., Range 117 W., Teton County, Wyoming.

5.1 DESCRIPTION OF THE PREFERRED ALTERNATIVE

The environmental restoration project would involve gravel removal and construction of channel stabilization pools; secondary channels leading to and from off-channel pools; off-channel pools; spur dikes (bank barbs and kickers); eco fences (both rock and piling fences); anchored root wad logs; and rock grade control structures. (For detailed tool descriptions, refer to paragraphs 5.1.1 to 5.1.9.) Head gates were eliminated as a restoration tool due to expense. The proposed tools would be used in various combinations within each of the four areas.

The environmental restoration measures were carefully sited and hydraulically analyzed with provision for the effects of structures and projected vegetation growth to assure that they would have no adverse impact on the flood control functions of adjacent levee projects. In fact, the environmental restoration measures were designed to stabilize the channel in areas where it approaches the levee, and to shift the channel away from the levees or eroding bank in other areas. Stabilizing the channel and shifting the channel away from the levees should reduce the potential for the river to affect the levees and potentially result in reduced maintenance and associated costs. Typical examples are in Areas 1 and 10 where eco fence groups were strategically placed in a manner as to restore a cushion of riparian vegetation between the main channel and the adjacent levees or eroding banklines.

Temporary water diversions or berms would be necessary at some locations to de-water gravel removal sites. Water diversion materials would be excavated from dry adjacent cobble, gravel, and sand deposits. The berms would be used to alternately de-water braided channels (to allow the channel capacity excavations to occur in non-flowing waters) and portions of channels to allow work (to occur outside of the flowing water). Following completion of work in the area de-watered by the berm, the berm material would be scooped and transported from the site for upland disposal.

Construction is dependent upon local sponsorship. The local sponsor would provide real estate easements and cost share 35 percent of the construction cost. The Corps is hopeful that construction can begin in 2001 and end in 2004. However, compliance with this schedule would be contingent upon the sponsor's participation. Construction would occur during low-flow conditions and would generally be limited to only one of the four areas each year.

The following tools have been identified for use in conditions occurring throughout the 500-year floodplain:

5.1.1 Gravel Removal

Gravel removal would be used to varying degrees in the implementation of the various environmental restoration tools to provide more channel stability and provide sediment deposition in controlled areas. Principally gravel removal would be used to improve fish habitat, compensate for reductions in channel capacity, increase channel stability, and improve sediment transport. Gravel removal would be used to construct channel stabilization pools, secondary channels, and off-channel pools. All gravel removal would be accomplished using a track-mounted excavator, rubber-tired backhoe, or other similar equipment (along with trucks to transport the material to disposal and stockpile sites).

Areas (from which gravel is removed to maintain channel capacity and to construct channel stabilization pools and off-channel pools) would be rearmored on the bottom surface using cobbles screened from the excavated material. Gravels, which are removed, would be either transported to a site located between the levees for screening or would be transported as unscreened material to an existing gravel processing facility off-site. Screening would separate out cobbles 4-inch plus in diameter or larger for use as armoring material. It may be necessary to temporarily stockpile the screened material. The 4-inch minus material would be transported from the screening location by truck for off-site upland disposal prior to anticipated high flows. The 4-inch plus cobble would be transported by dump truck from the screening site to the channel capacity, side pool, and channel stabilization pool excavation sites and placed to rearmor the disturbed bed. The material would be dumped in wind-row fashion, perpendicular to the normal stream flow to allow subsequent high flows to naturally disperse the material. The 4-inch plus cobble would be placed prior to anticipated high flows.

5.1.2 Channel Capacity Excavations

Channel capacity excavation would be used to offset reductions resulting from construction of the environmental restoration tools and effects of the tools upon channel structure and function. Additionally, channel capacity excavation would compensate for ongoing channel aggradation and loss of channel capacity. Channel capacity would be reduced by the installation of anchored root wad logs; discharge of riprap to construct rock eco fences, spur dikes, and rock grade control; and from the deposition of bedload material and resultant regeneration of vegetation. Bedload deposition would be intentionally triggered by structures such as the eco fences and anchored root wad logs. Channel capacity excavations would be necessary to compensate for the effects of the environmental restoration project and maintain the 100-year base flow for flood protection.

Gravel would be removed from specific areas of the channel to compensate for the decreases in channel capacity. Gravel would be removed within the general vicinity of the areas identified on plates 2, 3, 4, 5, and 6.

5.1.3 Channel Stabilization Pools

Channel stabilization pools reduce flow velocity, catch bedload material, and reduce the transport of bedload material to downstream areas, which may already have an over abundance of material. These functions improve channel stability and improve fish habitat through the creation of a large pool. Channel stabilization pools would be excavated in strategically selected locations to trigger the deposition of bedload material and sediments. See plates 2, 3, 5, and 6 for approximate locations.

5.1.4 Secondary Channels

Secondary channels, also referred to as supply channels, are typically smaller channels, which parallel the main river channel. Secondary channels vary in size and depth and may carry flows year-round or only during periods of high water. These channels help disperse flows and suspended sediments throughout the floodplain and provide valuable aquatic habitat.

Secondary channels would be constructed in selected locations to improve flows to existing off-channel pools or provide flows to newly constructed pools. See paragraph 5.1.5 for discussion of off-channel pools. Some secondary channels exist within the leveed sections of the river. However, because of accelerated flows, the channels are degraded or plugged. Gravel and cobble would be excavated to either enhance existing secondary channels or to construct new channels. See plates 2, 3, 4, 5, and 6 for approximate secondary channel locations and typical design.

Because of the remote locations and potential disturbances to wetland and riparian vegetation by trucks accessing the excavation sites, dredged cobble, gravel, and sand would either be scooped and side-cast on the adjacent gravel deposits or transported from the site for upland disposal. The determination of whether to side-cast material or transport it from the site would be based upon the potential impacts of ingress and egress of trucks to the site. If dump truck access routes are available, which would have minimal disturbance upon vegetation, the material would be scooped and transported to a permitted gravel processing facility for disposal. Excavated gravel and cobble may be screened, depending upon the proximity of the site to the gravel screening area and anticipated need for 4-inch plus cobbles to rearmor excavation sites. Side-cast material would be uniformly spread on adjacent unvegetated gravel deposits below the ordinary high water mark (OHWM), in the dry and above the low flow of the river. Fine sediments such as silts, sands, and soils would be placed in locations to promote riparian habitat restoration.

5.1.5 Off-Channel Pools

Off-channel pools provide important spawning and rearing habitat for cutthroat trout. Access to potential spawning areas in spring creeks and secondary channels and pools has been severely reduced by construction of the levees. This lack of adequate spawning habitat is considered a major limiting factor for cutthroat trout in the Snake River.

Off-channel pools would be constructed within the alignment of the secondary channels to provide rearing habitat for cutthroat trout. See plates 2, 3, 4, 5, and 6 for approximate locations and typical design. Some existing pools would be used and may only require limited excavation to enhance their function. Other pools would require complete excavation.

Excavated cobble, gravel, and sand would be either scooped and side-cast on the adjacent gravel deposits or transported from the site for upland disposal. Depending upon the proximity of the site to the gravel screening area and anticipated need for 4-inch plus cobbles, the excavated gravel may be screened. Side-cast material would be uniformly spread. Side-casting would occur below the OHWM, in the dry, and above the low flow of the river. The determination of whether to side-cast material or transport it from the site would be based upon the potential impacts of ingress and egress of trucks to the site and the opportunity to enhance riparian habitat as described above. If dump truck access routes are available, which would have minimal disturbance upon vegetation, the material would be scooped and transported to a permitted gravel processing facility for disposal.

5.1.6 Spur Dikes

Spur dikes would provide areas of resting habitat close to areas of high velocity, which may transport high quantities of aquatic insects used as food by cutthroat trout and other species and provide protection against bank erosion. Spur dikes would be installed in areas where stream velocity is normally too high for fish to spend much time. These resting areas may be further enhanced with the incorporation of large-woody debris on the downstream side. The large-woody debris would be placed in areas of ineffective flow.

Spur dikes consist of a series of either kickers or bank barbs extending into the channel from the adjoining levee. See plates 2, 3, 5, and 9. Riprap used to construct the spur dikes would consist of large angular rock, free of fines. It is likely that spur dike construction would require in-water work. Both kickers and bank barbs would be composed of riprap armor. Kickers may extend as much as 60 feet from the levee. Random fill excavated to embed the kickers would be used as the core material. Equipment used to excavate for the kickers and to place riprap would sit atop the levee and would maneuver onto the top of kickers, when necessary. Bank barbs, which are smaller than kickers, would extend up to 30 feet into the channel from the levee. Both type of structures would be embedded into the levee.

Photo 5-1. Bank Barb.

5.1.7 Eco Fences

Eco fences block, slow down, or deflect the force of the current during high-flow periods in order to protect existing islands and vegetation and to cause deposition of sediment where new vegetation may become established. Eco fences will allow the river to heal itself. Rather than the costly and disruptive process of placing sediments with heavy equipment, the river will be allowed to do the work through a natural process. See plates 2, 3, 4, and 5 for general eco fence locations. Eco fences would be placed at the front and sides of existing wooded islands to prevent/inhibit further soil and vegetation loss or placed in areas where soil and vegetation have already been lost to facilitate deposition and vegetation regrowth. As vegetation becomes established, it will further slow flow velocities and encourage accelerated sedimentation. Indirect aquatic habitat benefits would be gained as vegetation is reestablished. As the amount of vegetation increases, shade and material (such as leaves and insects that fall into the river, providing nutrients to river organisms) would also increase while ensuring the future availability of large-woody debris input to the river.

Two different types of fences: piling eco fences (see photo 5-2, below) and rock eco fences, may be used. See plate 8 for detailed drawings. Piles would be driven and have interconnecting cables attached. Rock eco fences, constructed of riprap, would require excavation to key the structure into the cobble, gravel, and sand substrate. Excavated material would be scooped and transported off-site for upland disposal. Riprap would be trucked to the site and dumped directly into the excavation site. Riprap used to construct the rock eco fences will be large, angular rock, free of fine sediment.

Photo 5-2. Piling Eco Fence, with Accumulated Woody Debris.

5.1.8 Anchored Root Wad Logs

Anchored root wad logs consist of tree trunks with the root attached. Depending on placement, anchored root wad logs may provide additional resting habitat for cutthroat trout and other fish species. The 1989 Jackson Hole Debris Clearance Environmental Assessment found that, "local scour and fill is also evident adjacent to woody debris left in the channel following the 1986 flood." Anchored woody debris may also encourage sediment deposition and help establish new vegetation (see photo 5-2).

Anchored root wad logs would be obtained from along the river channel within the four project areas or from commercial sources. Logs would be transported to the installation site by either truck, rubber-tired skidder, or helicopter. See plates 2, 3, 4, and 5 for approximate locations. A backhoe may be used to level an area to place the logs so that the logs would have uniform bearing along the trunk and its root would be partially embedded. The logs would be fastened down with toggle bolt anchors. The anchors would be driven into the ground with a jackhammer and a jack would be used to pull up on the anchors locking them into place. The cable would be tied around the logs and cinched down to tighten the logs to the ground. (See photo 5-3.)

Photo 5-3. Naturally occurring root wad logs and accumulated organic matter (woody debris). This would be replicated by anchoring root wad logs. During periods of high flows the anchored logs would trap smaller woody debris.

5.1.9 Rock Grade Control

Rock grade control structures keep the river from eroding and destroying existing riparian areas. Riprap would be placed at specific areas where down-cutting of the channel threatens channel stability. Existing cobble, gravel, and sand would be removed to a standard uniform depth of 3 feet below the ground surface. See plates 4 and 9. The material would be scooped and transported off-site for upland disposal. This area would then be graded and refilled with riprap to match existing topography. Riprap would be transported to the site by truck, dumped, and spread using the anchore track-mounted excavator. Riprap used to construct the rock grade control would be large-angular rock, free of fine sediments.

5.2 MONITORING AND MAINTENANCE

Monitoring would be conducted during construction to ensure compliance with various requirements identified in the Biological Assessment (BA) (appendix A) and the Fish and Wildlife Coordination Act Report (CAR) (appendix B). Monitoring would also be conducted following completion of construction to assess changes to aquatic and terrestrial habitat; to identify effects of river flows on the structures, as well as effects of the structures on the river; and to identify the need for structure maintenance. Monitoring procedures for structure integrity and function and for aquatic and terrestrial habitat changes would be identified in a monitoring plan that would be developed prior to completion of the Jackson Hole, Wyoming, Environmental Restoration Project. The monitoring plan would be coordinated with the local sponsor and appropriate resource agencies prior to finalization. The local sponsor would monitor and maintain the environmental restoration measures.

During the first few years of use, an elevated level of maintenance may be necessary until information is gathered that may identify more efficient uses of structures. Certain structures are likely to require maintenance to ensure they continue to function as designed. The shifting nature of the braided river is expected to have some effect upon the structures; however, the extent of effects would vary between structures and from site to site depending upon river conditions. Some structures may require only minor maintenance while others might require substantial reconstruction. The frequency with which maintenance may be necessary and the extent of necessary repairs would be dictated by the frequency and extent of river effects upon the structures. Maintenance would likely be necessary to maintain and ensure the proper function of eco fences, secondary channels, channel stabilization pools, spur dikes, and off-channel pools. Maintenance is not expected to be necessary on the remaining environmental restoration tools; however, monitoring would be necessary to assess the need for maintenance.

It is unlikely that vegetative growth from the environmental restoration project will adversely impact flood control. The channel typically has adequate room to adjust its location and conveyance. This is particularly true if the channel alignment is stabilized and excessive erosion is reduced. The designated mid-channel pool areas will provide a means of maintaining adequate conveyance by removing excessive gravel before it has an opportunity to build up in the channel. However, it will be important to assure that “maintenance” does not involve activities that progressively increase the cross-sectional area of protected vegetation at any point along the channel beyond that indicated in the original design drawings.

Maintenance of environmental restoration tools would be conducted in accordance with the limitations and restrictions of the EA and its appendixes. The local sponsor would be responsible for acquiring permits necessary to implement maintenance.

Monitoring and repairing of Jackson Hole Flood Control Project access roads and levees (affected by construction and subsequent maintenance activities) are discussed in paragraph 6.6 Transportation.

5.2.1 Channel Stabilization Pools

The quantity of sediment being transported downstream cannot be precisely calculated and is expected to vary from year to year. Because of this, the optimum size of channel stabilization pools, and their anticipated effectiveness, is not known. Removal of gravel from channel stabilization pools, to maintain channel stabilization pools, would generally occur when one-half or more of the original channel stabilization pool gravel volume is refilled. Only about 50 percent of the original trap area would need to be disturbed to remove the quantity necessary to maintain the trap. Excavation would not vary from or exceed the original trap design. The traps would have to be closely monitored to ensure excessive excavation does not occur. Under average conditions, several years may be necessary to fill the traps; however, it is possible that a single flood event could fill the traps completely. Experience over time will determine the appropriate level of maintenance.

5.2.2 Secondary Channels

The deposit of gravel and subsequent blockage of the upper end of the channel would necessitate maintenance. If groundwater is inadequate, the secondary channels would need to be reopened to provide an adequate inflow of water for the downstream pools. Gravel blockages would be excavated sufficiently to provide 2 to 3 cubic feet per second (cfs) flow. Excavated gravel would be side-cast due to the anticipated small quantity.

5.2.3 Off-Channel Pools

Off-channel pools would be subject to refilling during high-flow seasons. Pools that are close to the main channel could be refilled with gravel and cobbles in a single high-flow season. Those farther away would likely last a number of years, refilling with silt and sand brought in by the interconnecting channels and by general over-bank flow during high-flow periods. Due to the braided nature of the river, it is nearly impossible to select locations where pools would always be protected from potential destruction by major flood flows or channel changes. Based on this, various approaches to maintaining off-channel pools would be used.

Pools near the margins of the active meander belt would be allowed to fill completely. A new pool would then be constructed nearby, without disturbing the old pool or its water supply. Where possible, the new pools would be built either upstream or downstream of the existing pools in order to use the same supply channels. Pools constructed near the main channel in the vegetation-free areas of the channel would be reexcavated only when completely filled with gravel. These channels could be filled in completely during a major event, which could also involve major changes in the main channel. The main channel may even cut a course through the center of a pool. In the latter case, the pool would be reexcavated at another location (probably along the previously abandoned channel). The objective would be to approximately maintain the same area of pools throughout the life of the environmental restoration project either by reexcavation at the same location or relocation of a pool to a more advantageous site. Maintenance would be performed during the low-flow period.

5.2.4 Spur Dikes

Spur dikes would occasionally be damaged by high flows. Measurements, taken at various locations on the existing channel, indicate that erosion can extend down to at least 15 feet below the high-water level. The mode of damage most likely to occur would be undercutting of the toe of the dike and collapse of material into the void with material being transported downstream. Maintenance of bank barbs or kickers would generally involve reestablishment of the toe and restoration to the original geometric outline. Maintenance could include placement of additional bank or toe protection, strategic placement of boulders or intermediate barbs to break up the undesirable flow pattern if undesirable flow patterns are created. In a worst-case scenario, the spur dike group can be removed. It is anticipated that a staged construction sequence will allow design adjustments to be made as experience is gained from the performance of these structures.

5.2.5 Eco Fences

Maintenance measures for the eco fences should provide for minimal adjustment of fence lengths or alignment, repair of damaged cables or piling, and reestablishment of the fence tie-off to the bankline if erosion damage threatens to destroy the function of the fence, increase bank erosion, or threaten adjacent flood control structures. This could involve removal of some portions of fence if it proved to be poorly aligned or improperly located.

Maintenance would most likely be necessitated by failed posts and fencing or by erosion around the landward end of the fence. Repair would involve reestablishment of the fence tie-off by extending the fence back to the undisturbed bankline. Repairs may include repositioning existing piles and cable, installing longer posts, reattaching the cables, or adding other material to trap debris. In some cases, it might be sufficient to drive and attach additional supporting posts in locations where the fence is beginning to sag or fail. Work would be done during low flows.

Depending upon how the river affects the fence site, maintenance work may or may not occur in the water. If a fence is failing to catch debris, trapping efficiency might be increased by adding a finer mesh screen that would capture smaller debris, or exposed areas may be covered by dragging some of the debris over to places where it is deficient. If debris is failing to be trapped or is being deflected around the fence, it may be necessary to add one or more fence panels oriented upstream near the end of each fence. In some areas, adjustments in the location or angle of eco fences may be needed if the river abandons the channel.

6.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

6.1 WATER

The Snake River and its tributaries in the upper Snake River Basin have regular patterns of natural seasonal flow with high flows during the months of May through July, receding flows in August and September, and low flows in the months of October through April. High flows in the late spring and early summer result from melting of the winter-accumulated snow pack, sometimes augmented by rain storms. Winter flooding due to thawing conditions and rain-on-snow conditions can occur but rarely result in damaging flows. For the period of record, maximum annual peak discharges have always coincided with the spring snowmelt season. Total annual runoffs for a given area vary with the amounts of precipitation received during the snow pack accumulation and the snowmelt seasons.

The porous and unconsolidated alluvial and glacial deposits in the valley are the major aquifers in Teton County. Much of the floodplain is close to the level of the river and laced with abandoned or relief channels. Due to the ready exchange of water between the river and the aquifer, channels that are abandoned or cutoff by levees often still contain flowing or standing water. Along the Snake River and its major tributaries, the aquifer can supply very large amounts of water. Water tables are often less than 5 feet below the ground surface for a significant portion of the year. Groundwater levels, reflecting the surface runoff patterns, are highest in the spring and early summer and lowest later in the fall and early winter. Spring-fed watercourses will rise in tandem with the snowmelt runoff in the main streams, but the increase in flow is of a much lesser magnitude and does not seem to approach damaging levels.

Numerous irrigated diversions remove water from the Snake River. The irrigation season generally lasts from about May 1 to October 1. There are currently eight active diversions within the Federal Levee Project area and an additional eight inactive diversions. Regulation by the use of storage space in Jackson Lake reduces the Snake River flow during October through May, or early June, and augments Snake River natural flows during July, August, and September in order to satisfy downstream irrigation requirements.

6.1.1 Opportunities for Water Flow Regulation Using Jackson Lake.

Changes in the operation of Jackson Lake could improve fish habitat and/or reduce erosion in the Snake River. Such changes might include regulation of peak flows and summer releases and regulation to augment minimum flows.

6.1.1.1 Regulation of Peak Flows and Summer Releases.

Between 1917 and 1956, Jackson Lake was regulated primarily in the interest of irrigation storage, with only incidental flood control benefits. These operational policies resulted in an average reduction in the annual unregulated peak discharges of about 4,600 cfs. Because the reservoir was occasionally refilled prior to the occurrence of the actual flood peak, in some years no significant control was achieved. During some low water years, the high summer irrigation releases exceeded the natural peak inflow. In addition, sustained high flows, at or near bankfull, were blamed for increased bank erosion in unleveed reaches of the river. In the 1940's, local interests began pressing for changes in the operation of Jackson Dam that would address the problem of local bank erosion. With the construction of Palisades Dam, up to 350,000 acre-feet of flood control space (25 percent of the total 1,400,000 acre-feet available in Palisades Reservoir) was made available for use in Jackson Lake operational plans.

The formal implementation of this provision went into effect in 1956 when the Palisades Water Control Manual was published. The primary objective of the provision was to limit flows to a maximum of 20,000 cfs below Palisades Dam while providing significant, but less reliable, control upstream. Typically, the Bureau of Reclamation evacuates a minimum of 200,000 acre-feet of space from Jackson Lake with releases that may be higher than inflow during the irrigation season. Additional space can be evacuated depending on runoff forecasts prior to May 1. If the reservoir has been drawn down below the minimum flood control space on October 1, this deficit may be recovered by gradually refilling during the winter. An attempt is made to limit releases to the 5,000 to 7,000 cfs range during the peak runoff period, although these may be reduced as necessary in an attempt to limit peak flows at the Flat Creek gage to 20,000 cfs. During the period 1956 to 1986, Jackson Lake regulation achieved an average reduction in the annual peak flow at the Wilson gage of 6,200 cfs, compared to 4,600 cfs prior to 1956. In the years since 1956, regulated peak flows at the Wilson gage have exceeded 20,000 cfs 4 times (in 1982, 1986, 1996, and 1997) compared to 12 times prior to 1956. However, of the 12 times prior to 1956, only 1 (in 1943) occurred during the period 1930 to 1956. The remaining 11 occurred prior to 1930.

Although flood control regulation has been improved by Jackson Lake operations, sustained, near bankfull flows in the Jackson Hole area (about 10,000 cfs) probably continue to contribute to bank erosion problems in the area outside the Federal levee reach. Based on records from the two U.S. Geological Service (USGS) gages, the Snake River near Wilson and below Flat Creek (from 1973 to 1986) sustained flows exceeding 11,000 cfs occurred an average of 4 weeks each year.

Flood control regulation between Jackson Lake and Palisades Reservoir has been less than optimum due to the high priorities placed on irrigation storage at Jackson Lake and the emphasis on flood control below Palisades Dam. But, unless major changes are made in Congressional authorizations for the Jackson-Palisades system and in current irrigation contracts and interstate compacts, any improvements arising from new studies would likely be marginal. The potential for peak flow reduction downstream of the Jackson Dam project is also limited by the fact that only about 38 percent of the Snake River runoff at the Flat Creek gage is controlled by Jackson Lake. To significantly improve the opportunity for peak flow reduction would require construction of additional upstream storage facilities.

6.1.1.2 Regulation for Minimum Flow Augmentation.

Jackson Hole is a recreational haven for thousands of visitors each year. Recreational fisheries are an important element in the all-season attraction of the region. Reservoir levels at Jackson Lake have been regulated to maintain optimum breeding and nursery conditions. This has usually meant holding the pool elevation constant from October 1 (the end of irrigation season and approximately the middle of Mackinaw egg-laying season) until the eggs hatch in the spring.

However, recognizing cutthroat trout as an important resource, fisheries managers have determined that a minimum stream flow of 280 cfs from Jackson Lake is required to support a healthy population of cutthroat trout. The optimum flow is 400 cfs, and flows above 600 cfs should be avoided. To implement this plan, the lake could be drawn down as much as 5 feet after October 1 to maintain stream flows below the dam. There is an attempt to meet the 280 cfs minimum but no formal minimum release requirement. The Bureau of Reclamation, *Operations Manual*, December 1997, states in part: “If the reservoir was drawn down to the minimum flood control space on October 1, then the release is set to match inflow. If the reservoir was drawn down below the minimum flood control space on October 1, then the release can be set to a minimum inflow or 280 cfs whichever is less. The release selected will allow the reservoir to either refill to the minimum flood control space gradually over the winter or refill as much as possible up to the minimum flood control space.”

Without Jackson Lake Dam, flows would have dipped below 400 cfs in each of the last 87 years and dropped below 280 cfs in 74 of those years. Statistically, stream flows have been less than 400 cfs 21.1 percent of the time and less than 280 cfs for 5.5 percent of the time.

With Jackson Lake Dam in place, there were 9 years since 1909 with average annual flows less than 1,000 cfs. The lowest average annual flow year was 1977 with an average annual flow of 660 cfs. If flows above 4,000 cfs are excluded because they occurred during floods and may not have been held by a moderate size dam, then there were 15 years with average annual flows less than 1,000 cfs. Of these, six occurred as back-to-back pairs. Again, the lowest average annual flow was 660 cfs in 1977.

During the construction of Palisades Dam in 1956, the Corps negotiated 800,000 acre-feet of nonexclusive flood control storage at the 2 projects with 25 percent coming from Jackson Lake and 75 percent coming from Palisades Dam. The agreement requires the Bureau of Reclamation to make the storage available between March 1 and May 1 each year unless the Corps and Bureau of Reclamation agree in advance that expected spring runoff would be better controlled by different operation.

Although snow melt forecasting has come a long way, the exact timing and quantity of runoff is still subject to considerable error. The 1997 spring runoff was nearly 50 percent greater than anticipated, forcing both dams into defensive operation and causing severe flooding downstream.

For the current study, a representative sample of flow periods was selected that reflect current operating needs of downstream irrigators as interpreted by the Bureau of Reclamation Reservoir Operations Center. Both 1992 and 1994 were classic low-flow years. The 5-year period extending from October 1991 through September 1996 appeared to provide a full range of possibilities including the two drought years of 1992 and 1994, as well as an unusually high runoff year in 1996. This period was selected for further detailed analysis.

Table 6-1 is a list of "natural" (flows assuming no Jackson Lake regulation) Snake River flows at the Jackson-Wilson Bridge ranked by peak flow and volume:

Table 6-1. Unregulated Flows at Snake River at Jackson-Wilson Bridge.

Ranking by Peak		**Ranking by Volume**	
Date	**Discharge (cfs)**	**Date**	**Volume (kaf[1/])**
06 06 97	34,120	06 06 97	3,970
06 02 86	32,520	06 24 71	3,565
06 16 74	30,540	06 10 96	3,414
06 13 18	30,230	06 29 82	3,369
06 10 96	30,090	06 02 86	3,297
06 24 71	28,170	06 02 56	3,248
06 02 56	27,550	06 16 74	3,235
06 09 81	27,530	06 21 43	3,233
06 29 82	26,070	06 09 72	3,230
06 09 72	25,590	05 26 13	3,205
06 20 17	24,790	06 13 18	3,176
05 21 54	24,430	06 14 27	3,155
05 27 28	24,240	06 13 65	3,149
06 08 12	23,420	05 27 28	3,087
06 06 57	23,330	06 06 76	3,062
06 14 27	23,260	06 20 17	3,057
06 13 65	23,210	05 21 25	2,962

[1/] 1,000 acre-feet.

Table 6-1. Unregulated Flows at Snake River at Jackson-Wilson Bridge (continued).

Ranking by Peak		Ranking by Volume	
Date	Discharge (cfs)	Date	Volume (kaf)
05 26 13	22,060	06 08 12	2,952
06 09 89	22,060	05 29 51	2,938
05 29 51	21,930	06 16 11	2,906
06 06 95	21,670	06 17 16	2,899
05 22 93	21,670	06 10 78	2,879
06 06 76	21,450	06 01 84	2,841
06 16 11	21,380	06 05 14	2,826
06 06 52	20,800	06 11 21	2,807
06 10 78	20,530	06 11 83	2,799
06 01 84	20,520	06 07 50	2,764
06 14 53	20,480	06 06 95	2,703
06 07 50	20,350	06 13 62	2,683
06 17 16	20,290	06 06 52	2,640
06 09 70	20,230	06 06 57	2,619
05 21 25	20,120	07 04 75	2,614
06 03 48	20,020	05 21 54	2,595
06 21 43	19,980	05 15 36	2,594
05 15 36	19,850	06 07 22	2,546
06 15 59	19,790	06 07 38	2,545
05 24 80	19,480	05 10 47	2,539
05 28 79	19,260	06 21 67	2,535
05 28 79	19,260	06 21 67	2,535
06 07 38	19,160	06 09 20	2,487
06 11 21	19,130	06 09 70	2,447
06 11 83	19,020	06 07 64	2,426
07 04 75	18,970	05 25 23	2,410
06 15 63	18,900	06 09 89	2,399
06 21 67	18,350	05 27 69	2,394
06 05 91	18,120	06 06 46	2,394
06 05 14	18,020	05 22 93	2,382
06 09 20	18,010	06 12 49	2,371
05 25 58	17,960	06 13 68	2,331
06 07 64	17,930	05 21 32	2,311
06 07 22	17,890	06 03 48	2,279
06 13 35	17,330	05 24 80	2,272
06 13 33	16,650	06 05 91	2,250
06 06 46	16,520	05 28 79	2,240
06 12 49	16,430	05 27 85	2,203
05 25 23	16,380	06 15 63	2,169
06 13 68	16,320	06 15 59	2,149
05 27 69	16,210	06 14 53	2,137

Table 6-1. Unregulated Flows at Snake River at Jackson-Wilson Bridge (continued).

Ranking by Peak		Ranking by Volume	
Date	**Discharge (cfs)**	**Date**	**Volume (kaf)**
05 21 32	15,960	05 17 39	2,113
06 13 62	15,720	06 09 42	2,106
05 10 47	15,710	06 25 45	2,103
06 13 55	15,490	05 24 29	2,092
06 25 45	15,460	06 09 81	2,073
05 27 61	15,390	06 13 35	2,065
05 27 85	15,010	06 13 33	2,044
05 31 66	14,990	05 30 30	2,031
05 21 73	14,820	06 11 90	2,028
06 09 42	14,350	05 31 66	2,017
05 28 37	14,270	06 13 55	1,975
05 13 94	14,190	05 21 73	1,952
05 24 29	13,730	06 02 44	1,935
06 11 90	13,420	06 01 15	1,917
06 03 60	13,300	05 28 37	1,900
05 28 88	12,590	05 24 26	1,882
05 30 30	12,370	05 28 19	1,851
05 28 19	12,330	05 25 58	1,821
05 17 39	11,120	05 26 41	1,818
05 26 40	11,080	05 27 61	1,806
05 26 41	10,880	06 03 60	1,805
05 18 24	10,780	05 19 87	1,780
06 01 15	10,620	05 26 40	1,733
06 02 44	10,390	05 18 24	1,707
05 24 26	10,290	05 13 94	1,642
05 08 92	9,870	05 08 92	1,640
05 19 87	9,700	05 28 88	1,617
06 09 77	8,820	06 02 31	1,433
05 07 34	8,690	05 07 34	1,399
06 02 31	8,610	06 09 77	1,328

Assuming reasonable forecasting, volume becomes a more important indicator of low-flow capability than peak flow. Not surprisingly, irrigation demands are higher in low-flow years than in normal years due to dry conditions everywhere else in the basin. The basin runoff volume for 1994 was the sixth lowest flow on record and in 1992 was the fifth lowest flow on record. The 1994 volume record was chosen as the test case for low-flow discharge because it is recent in history and had a very low flow. Irrigation demands in 1992 were considered too extreme for the present analysis.

The 1994 hydrograph of mean daily flows indicated the summer runoff of July subsided into the irrigation demand curve of August. The 1994 irrigation demand was then superimposed on the 5-year test period from October 1, 1991, to December 12, 1996, to determine if optimum low flows could be maintained.

The U.S. Army Hydrologic Engineering Center's (HEC) model HEC-5, "Simulation of Flood Control and Conservation Systems," was used to route the flows through Jackson Lake. The following four criteria were used for annual flow routing:

- maintain a minimum flow of 400 cfs below the dam;
- maintain minimum irrigation flows at Jackson-Wilson Bridge equal to 1994;
- draw Jackson Lake down to elevation 6,755 by October 10; and
- do not exceed 15,000 cfs at Jackson-Wilson Bridge.

The 1994 irrigation demand curve was repeated during each year of the simulation. The simulated hydrograph indicated that a low flow of 400 cfs was maintained even during the two drought years of 1992 and 1994. This analysis indicated that the 400 cfs minimum could be maintained during the winter if irrigation demand was the same each year. In the draught year of 1992, the irrigation demand was considerably higher than normal, resulting in an October 1 pool level that was several feet lower than would normally occur at this time of the year. It was so low that it would not have been possible to refill the reservoir if 400 cfs had been released during the fall and winter months. Based on the analysis to date, it appears that the 400 cfs could be maintained during normal flow years, but that during drought years similar to 1992, this level of release could not be achieved while still meeting the irrigation demands for the following year. It should be emphasized that the Bureau of Reclamation operates Jackson Dam. They are in a better position to consider all of the operational constraints and should be the agency that makes the final determination whether additional winter-flow augmentation is possible.

6.2 AQUATIC ENVIRONMENT

A wide variety of aquatic organisms are located within the environmental restoration project boundaries. Construction and maintenance of the restoration can cause short-term adverse impacts to some of these organisms. The long-term positive benefits created through the successful environmental restoration project would far outweigh these short-term impacts. A period of several years between maintenance excavations would be desirable. This would help minimize recurring impacts to the aquatic environment. Impacts to various groups of organisms are discussed in the following sections.

6.2.1. Fish

6.2.1.1 Cutthroat Trout

Cutthroat trout are the main fish species of concern in the environmental restoration project area. The WGFD has designated the Snake River in the project area as a Class 1 or a blue ribbon trout stream. This indicates that the river is of national importance as a trout stream and should receive high priority for protection (Kiefling 1978, Corps 1989). Cutthroat trout populations in the area are mainly limited by lack of adequate spawning areas. Access to spring creeks and side channels, which are used for spawning, has been severely reduced due to construction of flood control levees. In addition to access restrictions, flow patterns within spawning channels have been altered, which further reduces useable spawning habitat.

Spawning habitat is considered one of the major limiting factors for cutthroat trout (USFWS 1988, Erickson 1980, Corps 1989). Most cutthroat trout spawning occurs during March through June in the spring creeks that enter the river along the project reach (Kiefling 1978, Corps 1989). The openings of many of these spring creeks are currently blocked by levees. Spawning is limited or non existent in the Snake River because of several factors. These include spring flows carrying high bedloads, high turbidity, human-induced modifications of the channel, and a cobble substrate that is typically too large for cutthroat trout spawning (Kiefling 1978, Erickson 1980, USFWS 1988, Corps 1989).

Another factor limiting cutthroat trout populations is the lack of overwintering habitat. Results from an in-stream flow study conducted above the project reach of the Snake River suggests that low-flow overwintering habitat is limited (Annear 1989, Corps 1989). Aquatic habitat associated with pools with cover present is often more important during winter low-flow periods (Lestelle and Cederholm 1984, Murphy et al. 1984, Swales et al. 1986, Bustard and Narver 1975b, Corps 1989). In many areas, it has been shown that structures formed by large-woody debris contribute significantly to the total habitat in streams for cutthroat trout and salmon (Corps 1989). Because of a lack of slow, deep pools, or other flow diversions, low flows and ice formation in the winter can severely limit habitat useable by cutthroat trout during the winter. Lack of overwintering habitat appears to cause high mortality in young age classes of cutthroat trout in the Snake River system (Kiefling 1978).

Baseline cutthroat trout habitat data was measured in October 1998. Resting pool area for use by cutthroat trout during the winter was the main habitat type considered. Figure 6-1 shows that fish habitat would increase as soon as environmental restoration project in-stream structures are installed. Additional figures for each work area can be found in appendix C. There may be a further increase as riparian vegetation increases. The “with project” projections shown in Figure 6-1 are based on implementation of all proposed structures and environmental restoration tools. If no action is taken, fish habitat would decrease in the future. It is important that habitat data is collected at the same time of year annually for the best comparisons between years.

Figure 6-1. All Four Areas - Fish Habitat Unit Projections.

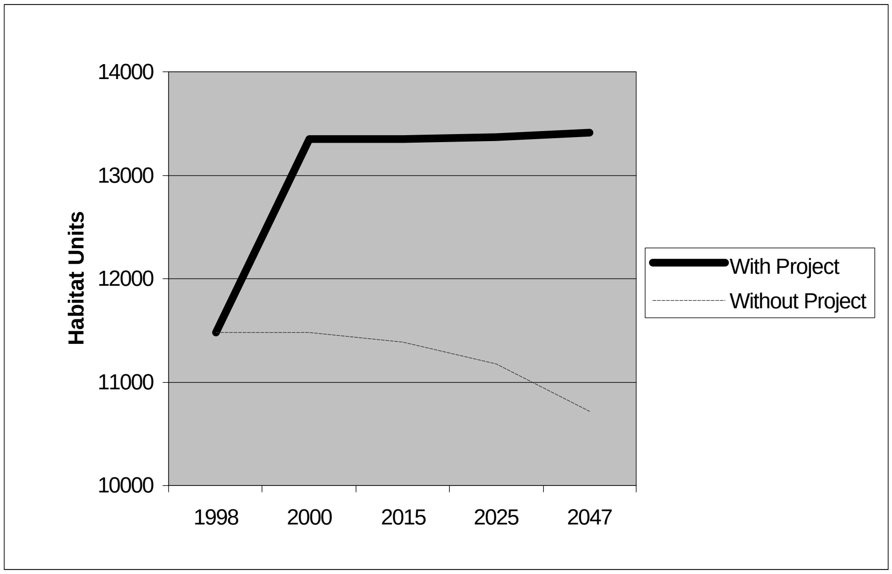


Table 6-2 lists the distribution of pool habitat type by area. There was an estimated 114,689 square feet of pool habitat in the evaluated sections of the areas.

Table 6-2. Square Feet of Pool Habitat Classes.

Area	Pool Class		Pool Area
1	3		1,076
	2		646
	1		9,903
		Total	**11,625**
4	3		23,412
	2		11,840
	1		11,087
		Total	**46,339**
9	3		1,830
	2		6,243
	1		15,070
		Total	**23,143**
10	3		4,305
	2		4,520
	1		24,757
		Total	**33,582**
		Grand Total	**114,689**

Pool class is important for determining the relative cutthroat trout habitat value for individual pool areas. Pools of different classes provide different amounts and quality of cover. Pool classes associated with the highest standing crops of cutthroat trout are assumed to be optimum. First class pools are large and deep. Pool depth and size are sufficient to provide a low velocity resting area for several adult cutthroat trout. More than 30 percent of the pool bottom provides cover due to depth, surface turbulence, or the presence of structures (*e.g.*, logs, debris piles, boulders, or overhanging banks and vegetation). The greatest pool depth is greater than or equal to 6.6 feet deep in streams greater than 16.4 feet wide.

Second class pools have moderate size and depth. Pool depth and size are sufficient to provide a low velocity resting area for a few adult cutthroat trout. From 5 to 30 percent of the bottom provides cover due to surface turbulence, depth, or the presence of structures. Typical second class pools are large eddies behind boulders and low velocity, moderately deep areas beneath overhanging banks and vegetation.

Third class pools are small or shallow or both. Pool depth and size are sufficient to provide a low velocity resting area for one to very few adult cutthroat trout. Cover, if present, is in the form of shade, surface turbulence, or very limited structure. Typical third class pools are wide, shallow pool areas of streams or small eddies behind boulders. Virtually the entire bottom area can be seen (Hickman et al. 1982).

This environmental restoration project is designed to increase the amount of overwintering and rearing habitat available to cutthroat trout, as well as to protect existing riparian areas from frequent high-water events. Total pool area within the study reaches would increase. Class 1 and 2 pools would increase most and provide the greatest benefit. Simply improving overwintering and rearing habitat may not increase the cutthroat trout population. However, by increasing these types of habitat, more or healthier cutthroat trout may survive to spawn, which could increase the population. Protecting and reestablishing vegetation between the levees would also be a benefit by providing organic material to the stream. This organic material could be used directly by fish in the form of terrestrial insects or cover, or indirectly when bacteria colonize on the organic material and are eaten by aquatic invertebrates that are then eaten by fish.

In-water construction would temporarily displace cutthroat trout from a few hours to a few months. Cutthroat trout may move into construction areas such as spur dikes as soon as equipment leaves the area. However, they may not inhabit large gravel removal areas for up to a few months until aquatic invertebrates recolonize the area. The area of impact would be limited because most gravel removal would take place in areas above the low-flow channel. Construction of eco fences and anchored-woody debris would have little effect on cutthroat trout as long as there are no in-water discharges. Spur dikes would create areas of low velocity resting habitat that would be used by cutthroat trout. Environmental restoration tools that protect or reestablish vegetation between the levees would provide a long-term benefit for cutthroat trout. Maintenance on the environmental restoration tools would have effects similar to construction. The least amount of activity necessary to maintain the environmental restoration tools would cause the least amount of impacts.

6.2.1.2 Other Game Fish Species

Mountain whitefish (*Prosopium williamsoni*) are abundant in the Snake River. This species may compete with cutthroat trout for food, but only at a limited level in the Snake River (Kiefling 1978, Corps 1989). Other salmonids are present in the region, but in relatively low abundance. They include brook trout (*Savelinus fontinalis*), brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*), lake trout (*Savelinus namaycuch*), and possibly grayling (*Thymallus arcticus*) (Kiefling 1978, USFWS 1988, Corps 1989).

An increased amount of overwintering habitat would also be used by these species. The overall population distribution is not expected to change. Construction, maintenance, and long-term effects for these game fish species would be similar to the effects on cutthroat trout.

6.2.1.3 Non-Game Fish Species

Suckers (Catostomids) are an important food source for bald eagles (USFWS 1988, Corps 1989). Sculpins (Cottids) are a major prey item for cutthroat trout (Kiefling 1978). Five species of minnows (Cyprinids) are present in the Snake River. These small fish may be used as prey by cutthroat trout (Kiefling 1978, Corps 1989).

Excavation within gravel removal areas may displace some non-game fish species. Some mortality on small fish is expected in areas of in-water excavation, such as sculpins and minnows that may hide in the substrate instead of leaving the area. It is not expected that this would have noticeable long-term population effects on these species. By creating temporary berms and working on dry gravel bars during low-flow periods, adverse effects would be minimized. Non-game fish may also avoid gravel removal areas until aquatic invertebrates recolonize the area.

If vegetation between the levees is dramatically increased and the amount of organic material in the river increases, it is possible populations of these species may increase, which could provide more food for species that prey on them. Maintenance would have effects similar to construction but be temporary and localized.

6.2.2 Aquatic Invertebrates

Aquatic invertebrates are a primary food source for all carnivorous fish in the Snake River. A variety of species are present. Kroger (1967) found that 98 percent of the sampled biomass was comprised of mayflies (Ephemeroptera), true flies (Diptera), caddisflies (Tricoptera), and stoneflies (Plecoptera). Four genera of caddisflies produce the highest biomass of insects in the Snake River. Kiefling (1978) found a similar composition and abundance in the Gros Ventre River.

Most aquatic invertebrates identified in the Snake River are herbivores and detritivores, although a few are carnivores (Kroger 1967). Of the six most abundant species of caddisflies, three are herbivorous and three are carnivorous. The mayflies are predominately herbivorous. The stoneflies have the most varied diet, being both herbivorous and carnivorous. The true flies are generally herbivorous. Their larvae are an important food source to carnivorous invertebrates.

There may be a decrease in abundance of aquatic invertebrates in gravel removal areas due to excavation. However, this decrease is expected to be short-term. By working on dry gravel bars during low-flow periods, adverse effects would be minimized. Aquatic invertebrates should recolonize gravel removal areas within a few months. The species composition would depend on factors such as velocity, depth, and substrate size. Species composition may change in areas where structures are installed that change the flow conditions.

The overall abundance of aquatic invertebrates should not change noticeably until organic material input and entrapment in the stream increases. This could lead to an increase in the abundance of aquatic invertebrates.

Maintenance would have little effect on aquatic invertebrates except in-water excavations, which could cause temporary localized reductions in some species.

6.2.3 Aquatic Plants and Algae

True aquatic communities are supported by standing or flowing water year-round and are composed primarily of white buttercup (*Ranunculus aquatilis*), yellow buttercup (*R. cymbalarai*), speedwell (*Veronica americana*), waterweed (*Elodea* spp.), pondweed (*Potamogeton* spp.), watercress (*Rorippa nasturtium-aquaticum*), water milfoil (*Myriophyllum* spp.), mare's tail (*Hippuris*), and duckweed (*Lemna* spp.). White buttercup commonly forms large mats in shallow, standing water. Mat-forming algae is also common in shallow, stagnant ponds. Liverwort and stonewart species are also common.

The cobble-gravel bottom communities are dominated by foxtail (*Alopecurus aequalis*), silverberry (*Eleagnus commutata*), willow (*Salix* spp.), timothy (*Phleum pratense*), sedge (*Carex* spp.), muhly (*Muhlenbergia*), sweet clover (*Melilotus officinalis*), horsetail (*Equistum* spp.), and dock (*Rumex* spp.).

Some plants would be impacted during construction and maintenance. They may be run over by equipment or dug up in excavation areas. However, the plants growing in gravel removal areas would generally only survive until the next high flow. As an additional measure, access routes to construction sites would be selected to minimize impacts to existing plants.

Creation of shallow, low velocity pools may encourage the growth of some aquatic plants and algae. Species compositions would be determined by factors such as depth, velocity, and available nutrients. This increase would only be present until the areas refill with bedload. Debris fences, channel stabilization, and anchored woody debris may provide enough protection to some areas to allow for longer survival of some plant species. This longer survival may provide bank stability and organic matter to the stream, as well as other environmental benefits. Maintenance impacts would be similar to initial construction impacts but be temporary and localized.

6.3 TERRESTRIAL ENVIRONMENT

This environmental restoration project, if implemented, would have great potential for improving the terrestrial habitat within the confines of the four areas. Habitat Evaluation Procedures (HEP) were used to determine the relative habitat values of the four sites. Habitat value is measured in relation to the wildlife species that derive benefit (*i.e*., cover, food, water, nesting, *etc*.) from the habitat.

Yellow warbler and song sparrow were chosen as the two species that would use the majority of the shrubby/woody habitat associated with the upper Snake River floodplain. A yellow warbler likes medium-sized shrub habitat comprised primarily of coyote willow and other willow species along streams. This type of habitat is referred to as riparian or palustrine scrub-shrub (PSS). The song sparrow likes thick brushy areas and dense forbs near streams. The habitat is comprised of rose, berry vines, currant, and young poplar trees referred to as understory riparian or palustrine forest (PF). The habitat values or habitat suitability indexes (HSI) are obtained by measuring the environmental variables associated with each species.

The acreage for the two habitat types (PSS and PF) were obtained for each work area by mapping the covertypes from aerial photography. The years of photography used were 1956, 1991, and 1996. From the acreage figures derived from these sets of photography, HSI values were applied to each acre of habitat. For example, if the song sparrow has an HSI of 0.5, then the habitat units found on 50 acres of PF is 25. If a yellow warbler has an HSI of 0.4, then the number of habitat units found on 100 acres of PSS is 40. The HSI values are always a figure between 0 and 1.

The trend of the habitat unit increases with the environmental restoration project and decreases with out the project for both the yellow warbler (PSS) and song sparrow (PF). Future habitat value is based on an estimate of vegetative growth or degradation that could result if the project is implemented as planned or if the area is left as it is today. Figures for each work area can be found in appendix C.

As depicted in figures 6-2 and 6-3, there is great potential for terrestrial habitat improvement along the river corridor between the levees if the environmental restoration project is implemented as planned. If the project is not implemented, the riparian vegetation in the river corridor would continue to degrade.

6.3.1 Vegetation

The vegetation in the upper Snake River drainage near Jackson, Wyoming, is typical of the central Rocky Mountain region. Upland vegetation types in the area include: sagebrush-grassland, lodgepole pine/Douglas fir, and subalpine fir/Engleman spruce (Corps 1994). The sagebrush-grassland type occurs on the glacial outwash plains and terraces above the floodplain. This type is dominated by sagebrush (*Artemisia tridentata*) and perennial grasses, *e.g.*, wheatgrasses (*Agropyron* spp.); fescues (*Festuca* spp.); and bluegrasses (*Poa* spp.). Forests dominated by lodgepole pine (*Pinus contorta*) occur at lower elevations (6,300 to 7,800 feet) along rivers and above the glacial outwash plain. Douglas fir (*Psuedotsuga menziesii*) intermixes with lodgepole pine, but is generally dominant only on ridge tops and east-facing slopes. Subalpine fir (*Abies lasiocarpa*) and Engleman spruce (*Picea englemanii*) dominate higher elevation (7,800 to 10,000 feet) forests (Corps 1994).

The floodplain along the Snake River and its tributaries includes mixed deciduous/coniferous forests and wetlands. Floodplain forest consists of narrow-leaf cottonwood (*Populus angustifolia*) and willow (*Salix* spp.) intermixed with Engleman and blue spruce (*Picea pungens*). Wetlands occur where the water table is high enough to support hydrophytic plants (*i.e.*, plant species that grow in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content). These include three major types: PSS, palustrine emergent, and aquatic bed (Corps 1994). The PSS wetlands are found primarily on stable gravel bars and dikes and are dominated by willow and mountain alder (*Alnus incana*). Sedges (*Carex* spp.), cattails (*Typha* spp.), and bulrush (*Scirpus* spp.) are the primary species in palustrine emergent wetlands. The dominant species in aquatic bed wetlands depend on bottom substrate. Aquatic beds along shorelines tend to support watercress. Pondweed is common in streams or ponds with silt bottoms; ballhead waterleaf (*Hydrophyllum capitatum*) occurs in rocky substrates (Corps 1994).

Over 30 rare plant species tracked by the Wyoming Natural Diversity Database (WYNDD) occur in the vicinity of Jackson Hole Levees (table 6-3; Corps 1994). None of these species are Federally listed or proposed as threatened or endangered, but three are protected on U.S. Forest Service (USFS) lands. Those species listed in table 6-3 are considered extremely rare (5 or fewer occurrences) to rare (21 to 100 occurrences) in Wyoming or regionally. It is highly unlikely any of these species occur within the work areas between the levees. The west side of Area 4 and east side of Area 1 would have wetland habitat that includes moist soil plants that may include those listed in table 6-3 (Corps 1994). Work should not take place outside of gravel bars or gravel channels that feed from the main river channel. Work would disturb the cobble soils within the river corridor. Care must be taken to minimize these disturbances. Monitoring for noxious weeds would be needed to ensure they do not spread within areas above the primary flood zone of the river channel.

6.3.2 Wildlife

The Jackson Hole, Wyoming, area is known for its diverse wildlife in the valley and surrounding mountains. The following paragraphs describe the dominant wildlife groups associated with the environmental restoration project areas. The WYNDD has tracked 25 species that occur in the vicinity of Jackson; 22 may use habitats near the environmental restoration project areas (table 6-4, Corps 1994). Five of these species are Federally listed as threatened or endangered and are discussed in paragraph 6.3.2.6. Most of the remainder are considered extremely rare (less than 5 occurrences) to rare (21 to 100 occurrences) in Wyoming and are discussed in the following paragraphs. Construction activity needed to conduct environmental restoration work would involve noise from heavy equipment and human presence. The degree of disturbance from these activities on wildlife would depend on timing and location.

The only habitat losses expected for the environmental restoration project areas would be associated with construction activities and would be short-term. These temporary losses would only affect the few wildlife species that use the relatively disturbed habitats currently associated with the levees and access roads.

Wildlife in the construction area would be disturbed by the environmental restoration work. Wildlife respond to disturbance either by avoidance or habituation. Short-term disturbance (such as that associated with the environmental restoration work) would probably cause temporary avoidance that may disrupt foraging/migration patterns or traditional use for a single season but would have no long-term effects. However, long-term disturbance might cause wildlife to avoid otherwise suitable habitat, effectively resulting in additional habitat loss. Species that cannot avoid disturbance, such as small mammals, may become habituated.

Since construction would occur during the day, mammals that are mobile and diurnal or nocturnal would be relatively unaffected by the associated disturbance. Some species may temporarily relocate bedding areas.

See table 6-5 for the Priority I, II, and III Wyoming Species as of 1997 (Deibert, P. pers. comm.). The lists are prioritized for the species of concern and the habitats that these species use. Habitats include stream class (Class 1 is a blue-ribbon trout stream) and big game critical range/parturition areas.

These species and ranges are valued from irreplaceable to high value within the WGFD. These species are not listed on the Federal list but are mentioned because of their local importance.

Figure 6-2. Summary of PSS Vegetation Projections.

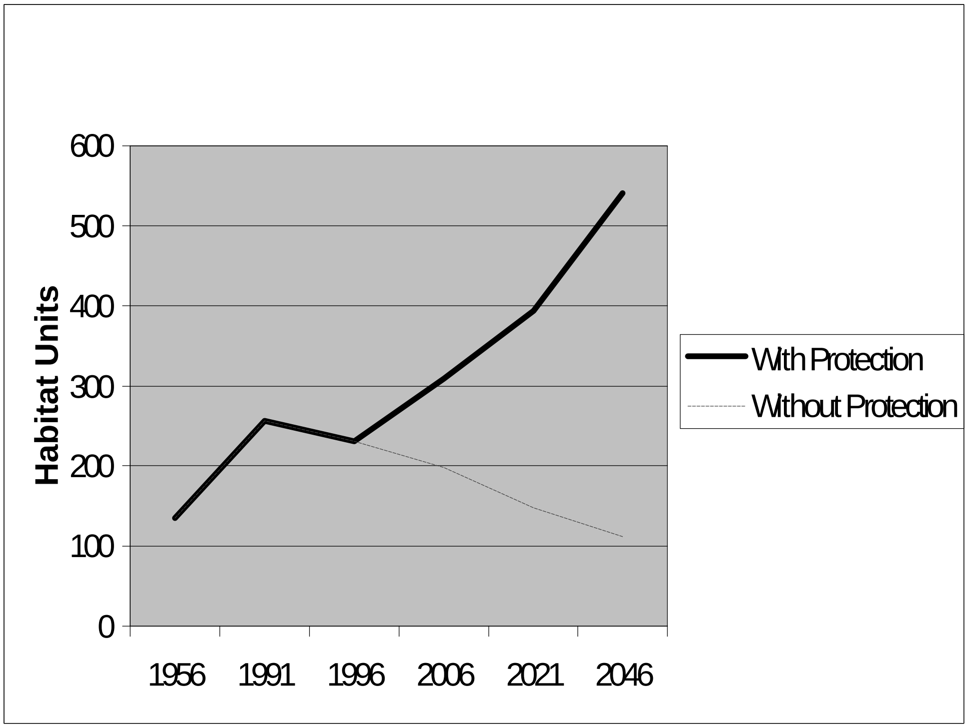


Figure 6-3. Summary of PF Vegetation Projections.

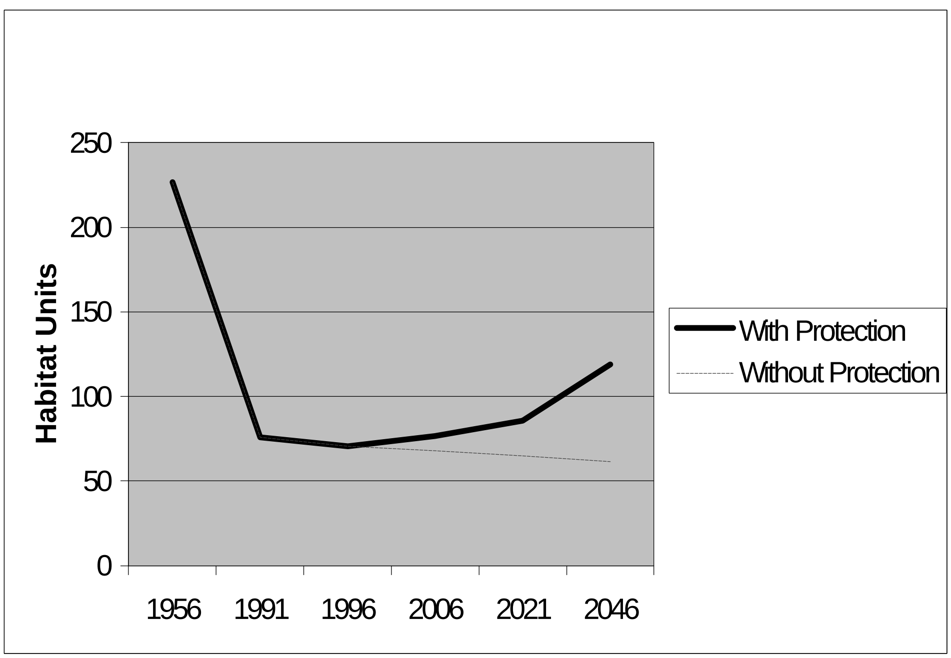


Table 6-3. Partial list of Plant Species Identified by the WYNDD that may Occur Near the Environmental Restoration Project Areas.[1/]

Common Name	Scientific Name	Federal Status[2/]	WY List & Rank[3/]	Habitat[4/]
Oak fern	*Gymnocarpium dryopteris*		2, S1	Moist banks of creeks; moist woods; and wetland/seep areas in spruce/subalpine fir forests on talus.
Steer's head	*Dicentra uniflora*		2, S2	Forest clearings; open slopes with sparse vegetation; rocky soils; sagebrush communities; and disturbed sites.
Boreal draba	*Draba borealis*	USFS	1, S1	Moist soils along streams and on shaded north-facing slopes; calcareous substrate/talus.
Marsh cinquefoil	*Potentilla palustris*		S2	Wetlands; moist places.
Railhead milkvetch	*Astragalus terminalis*		2, S1	Sagebrush grasslands on westerly slopes; river bottoms.
Nuttall townsend-daisy	*Townsendii nutalli*		3, S3	Sandy open areas.
Southern naiad	*Najas guadalupensis*		S1	Warm ponds.
Nodding fescue	*Festuca subulata*		S2	Wet thickets; moist to dry woods; meadows.
Frie's pondweed	*Potamogeton friesii*		S1	Shallow water.
Blunt-leaf pondweed	*Potamogeton obtusifolius*		2, S1	2 to 4 feet of water over soft, mucky bottoms.
Buxbaum's sedge	*Carex buxbaumii*		2, S2	Along shorelines; wet meadows next to lakes.
Fernald alkali grass	*Puccinella fernaldii*		2, S1	Willow thickets, usually in water.
Pale duckweed	*Lemna valdiviana*		2, S1	Warm ponds.
Giant helleborne	*Epipactis gigantea*	USFS	1, S1	Moist meadows in vicinity of calcareous ponds; streambanks; lake margins; and near springs.
Broad-leaved twayblade	*Listera convallariodes*	USFS	2, S1	Grassy areas under aspen-alder.

[1/] Species from the WYNDD were excluded from the list if they are generally restricted to habitat types (*i.e*., alpine talus and wet limestone cliffs) that do not occur near work areas.

[2/] Federal Status: C2 - Category 2 candidate for Federal listing as threatened or endangered. Current data insufficient to support listing.
USFS - Species is considered sensitive by the USFS.

[3/] State List: List 1 (Highest Priority) - Includes the following: (1) Federally listed and proposed threatened and endangered species and category 1 and 2 candidates for listing (except where current data indicate such status is inappropriate); (2) species designated sensitive on Federal lands or that are being recommended for sensitive designation by the WYNDD; and (3) other species that are quite rare and/or threatened globally or regionally but that have no formal protection status. List 2 (Medium Priority) - Includes the following: (1) species on designated Watch Lists for Federal lands or that are being recommended for Watch Lists by WYNDD, and (2) other species that are moderately rare and/or somewhat threatened globally or regionally. List 3 (Lowest Priority) - Includes the following: (1) species previously considered high or medium priority, but downranked as new information became available, or (2) species that are rare in Wyoming, but common and secure in adjacent areas.

State Rank: S1 - critically imperiled in the state because of extreme rarity or vulnerability to extirpation (5 or fewer occurrences); S2 - imperiled in the state because of rarity or vulnerability to extinction (6 to 20 occurrences); S3 - rare or uncommon in the state (21 to 100 occurrences).

[4/] Habitat: As described in the WYNDD and Hitchcock and Cronquist 1981.

Table 6-4. Partial List of Wildlife Species Identified by the WYNDD that may Occur Near Environmental Restoration Project Areas.[1/]

Common Name	Scientific Name	Federal Status[2/]	WY List & Rank[3/]	Mgmt. Status[4/]	Habitat[5/]
Boreal western toad	*Bufo boreas boreas*	C2	S2		Wide variety of habitats-streams, woodlands, meadows.
Spotted frog	*Rana pretiosa*	C2	S3	S-USFS	Near permanent water.
Northern leopard frog	*Rana popiens*		S3S4		Wide variety of habitats.
Common loon	*Gavia immer*		S2BS4N	I-WGFD S-USFS	Lakes.
Trumpeter swan	*Cygnus buccinator*	C2	S1S2BS2N	I-WGFD S-USFS	Lakes, rivers.
Harlequin duck	*Histrionicus histrionicus*	C2	S2BS2N	S-USFS	Swift streams.
Osprey	*Pandion haliaetus*		S3S4BS4N		Along rivers/streams/lakes.
Bald eagle	*Haliaeetus leucocephalus*	LE	S1BS2N		Primarily along rivers and other waterbodies.
Northern goshawk	*Accipiter gentilis*	C2	S4BSZN		Conifer forests; hunts in open areas.
Merlin	*Falco columbarius*		S2S3BSZN	II-WGFD	Open forests and a variety of habitats.
Peregrine falcon	*Falco peregrinus anatum*	LE	S1BS1N		Open wetlands near cliffs.
Whooping crane	*Grus americana*	LE	SHBS1N		Freshwater marshes.
Long-billed curlew	*Numenius americanus*	3C	S3BS4N	III-WGFD	Wet and dry grasslands.
Flammulated owl	*Otis flammeolus*		S1BSZN	S-USFS	Woodlands.
Great gray owl	*Strix nebulosa*		S2B2N	S-USFS	Dense conifer forest; hunts in open wet areas.
Silver-haired bat	*Lasionysteris noctivagans*		S3		Dense conifer forest; hunts in open areas.
Hoary bat	*Lasiurus cinerus*		S3	III-WGFD	Dense conifer forest; hunts in wet open areas.
Long-eared myotis	*Myotis evotis*		S5		Dense conifer/mixed forests; hunts in forests and near water, wetlands.
Gray wolf	*Canis lupus*	LE	SH		Wide variety of habitats.
Grizzly bear	*Ursus arctos*	LT	S1S2		Wide ranging-almost all habitat types.
River otter	*Lutra canadensis*		S3	III-WGFD	Rivers and streams.
American bison	*Bison bison*		S4		Grasslands, open areas.

[1/] Species from the WYNDD were excluded from the list if they are generally restricted to habitat types *(i.e.,* alpine talus and wet limestone cliffs) that do not occur in the vicinity of a potential quarry or access/crossing sites.

[2/] Federal Status: LE - listed endangered; LT - listed threatened; C2 - Category 2 candidate for Federal listing as threatened or endangered. Current data insufficient to support listing; and 3C - once considered for listing as endangered or threatened but no longer receive such consideration.

[3/] State Rank: S1 - critically imperiled in the state because of extreme rarity or vulnerability to extirpation (5 or fewer occurrences); S2 - imperiled in the state because of rarity or vulnerability to extinction (6 to 20 occurrences); S3 - rare or uncommon in the state (21 to 100 occurrences); S4 - apparently secure in the state (many occurrences); S5 - demonstrably secure in the state. For migratory birds, each of these categories is assigned to breeding status (B) and migratory status (N); SZN - species are not of significant concern when migrating through Wyoming; and SHB - historical breeder. State ranks may fall between 2 categories (*i.e*., S1S2B).

[4/] Management Status: I-WGFD (Priority I) - includes federally listed endangered and threatened wildlife as well as species in need of immediate attention and active management to ensure that extirpation or a significant decline in population does not occur; II WGFD (Priority II) - species that are in need of additional study to determine whether intensive management is warranted; III WGFD (Priority III) - species whose needs should be accommodated in resource management planning but do not need intensive management; S-USFS - species is listed as sensitive by the USFS in Region 4 (includes the Bridger-Teton National Forest).

[5/] Habitat: As described in the WYNDD; Stebbins 1985; National Geographic Society 1987; Brown 1985.

Table 6-5. Priority I, II, and III Wyoming Species as of 1997.

Priority I Species Wyoming (which could occur in study area):

American white pelican (*Pelicanus erythrorhynchos*)
Trumpeter swan (*Cygnus buccinator)*
Black crowned night heron (*Nycticorax nycticorax*)
Common loon (*Gavia immer)*
White-faced ibis (*Plegadis chihi*)
Snowy egret (*Egretta thula*)
Caspian tern (*Sterna caspia*)
Forster's tern (*Sterna forsteri*)

Priority II Species Wyoming (which could occur in study area):

Clark's grebe (*Aechmophorus clarkii*)
Western grebe (*Aechmophorus occidentalis*)
American bittern (*Botaurus lentiginosus*)
Merlin (*Falco columbarius)*
Upland sandpiper (*Bartramia longicauda*)
Black tern (*Chidonias niger*)
Burrowing owl (*Athene cunicularia*)

Priority III Species Wyoming (which could occur in study area):

Long-billed curlew (*Numenius americanus)*
Great blue heron (*Ardea herodias*)
Ferruginous hawk (*Buteo regalis*)
Black-backed woodpecker (*Picoides arctus*)
Masked (Preble's) shrew (*Sorex cinereus*)
Merriam's shrew (*Sorex merriami*)
Hoary bat (*Lasiurus cinerus)*
Wolverine (*Gulo gulo*)
River otter (*Lutra canadensis)*
Lynx (*Felis lynx*)

Other species not listed above:

Loggerhead shrike (*Lanius ludovicianus*)
Goshawk (*Accipiter gentilis)*
Spotted frog *(Rana pretiosa)*
Harlequin duck (*Histrionicus histrionicus)*
Elk (*Cervus elaphus nelson*)
Moose (*Alces alces shirasi*)
Mule deer (*Odocoileus hemionus hemionus*)
Bighorn sheep (*Ovis canadensis canadensis*)

6.3.2.1 Mammals

Elk (*Cervus elaphus nelson*), mule deer (*Odocoileus hemionus hemionus*), Shiras moose (*Alces alces shirasi*), bighorn sheep (*Ovis canadensis canadensis*), and American bison (*Bison bison*) are the most prominent wildlife in the Jackson Hole, Wyoming, area. Aquatic furbearers, black bear (*Ursus americanus cinnamomum*), coyote (*Canis latrans*), and a variety of small and medium-sized mammals also occur.

6.3.2.2 Big Game

Big game concerns focus on usage patterns within the region of Jackson Hole, Wyoming. Important winter feeding areas are located near the work area and migration patterns to and from these feeding areas go through the Snake River drainage. The usage patterns include spring-summer-fall range, winter range, winter/year-long range, critical winter range, and critical winter/year-long range (Corps 1990). The local mule deer, elk, moose, and bighorn sheep herds represent these types of usage. The critical range areas are the areas of greatest concern. Most conflicts would be avoided with the time restrictions imposed by river flows. If heavy excavations (gravel removal and sorting) are performed early in the work window and work takes place during daylight hours, conflicts would be minimized even further. It is recommended by the WGFD to cease work by November 15. Depending on the year, there may be opportunities to extend the work window into December or beyond if WGFD biologists are consulted and conditions warrant an extension.

The Jackson Hole, Wyoming, area has one of the largest populations of elk in North America. Jackson Hole and the surrounding mountains provide about 1,000 square miles of summer range for approximately 15,000 elk. During the winter, the populations concentrate in much smaller areas. The National Elk Refuge just northeast of Jackson, Wyoming, provides about 24,000 acres of winter habitat for 10,000 elk. The refuge includes winter range and a supplemental feeding area for elk (Corps 1994). The WGFD classifies this refuge as a crucial winter range, which is defined as one that determines whether the elk population in the area reproduces and maintains itself at or above WGFD target levels. In addition to the refuge, there are several other smaller wintering areas used by elk in the upper Snake River drainage (Corps 1994).

The Jackson Hole, Wyoming, area provides habitat for mule deer throughout the year. Mule deer use the area primarily for migration. The Sublette herd winters in the Green River Basin to the east. A small herd of mule deer winter in the South Park Elk Feed Grounds area (Corps 1990).

The upper Snake River drainage provides year-round habitat for about 200 to 300 moose. During the winter, an additional 400 to 500 moose from the surrounding uplands migrate into the river bottom area (Corps 1994). Winter densities range from 4.3 moose per mile between the South Park and Wilson Bridges to 6 moose per mile between Wilson Bridge and the confluence of the Gros Ventre River (Corps 1994).

Bighorn sheep are present seasonally in all major drainages within the Snake River and Gros Ventre River Basins (Corps 1994). The Gros Ventre drainage contains the primary wintering area for bighorn sheep that summer in the Gros Ventre Wilderness. In addition, a major wintering area occurs at Camp Davis, approximately 4 miles southeast of the confluence of the Hoback River. Sheep use steep slopes and breaks along the Snake and Hoback Rivers year-round. Brush and grassland areas at high elevations, within these drainages, are the primary feeding areas for bighorn sheep (Corps 1994). The following are big game usage for the specific environmental restoration project areas:

Area 1

This area has been designated as a critical moose (Sublette unit) wintering/year-long area. Deer, elk, bighorn sheep, and moose migrate through the area from side canyons. Elk from the Fall Creek unit migrate to reach the state feeding grounds located downstream of this site. Elk use the area primarily for winter range. Bighorn sheep of both the Targhee and Jackson units and mule deer of the Sublette unit use the area primarily as spring, summer, and fall range. Since most work would be conducted in late summer and early fall, conflicts with the winter migration should be minimal. If weather conditions are such that big game migrate early, then conditions (deep snow) would be such that construction activities would be halted. To avoid conflicts with migrating big game, work should cease by November 15, unless prior coordination with WGFD has taken place.

Area 4

This area is critical moose (Sublette unit) wintering/year-long use area. Deer, elk, bighorn sheep, and moose migrate through the area from side canyons. Elk from the Fall Creek unit migrate to reach the state feeding grounds located downstream of this site. Elk use the area primarily as winter range. Bighorn sheep of the Targhee unit and mule deer from the Sublette unit use the area for spring, summer, and fall range. Since most work will be conducted in late summer and early fall, conflicts with the winter migration should be minimal. If weather conditions are such that big game migrate early, then conditions (deep snow) may be such that construction activities would be halted. To avoid conflicts with migrating big game, work should cease by November 15, unless prior coordination with WGFD has taken place.

Area 9

This area is critical moose (Jackson unit) wintering/year-long use area. Deer, elk, bighorn sheep, and moose migrate through the area from side canyons. Elk of the

Jackson unit use the area primarily for migration. Bighorn sheep of the Targhee unit and mule deer from the Jackson unit use the area for spring, summer, and fall range. Since most work would be conducted in late summer and early fall, conflicts with the winter migration should be minimal. If weather conditions are such that big game migrate early, then conditions (deep snow) may be such that construction activities would be halted. To avoid conflicts with migrating big game, work should cease by November 15, unless prior coordination with WGFD has taken place.

Area 10

This area is critical moose (Jackson unit) wintering/year-long use area. Deer, elk, bighorn sheep, and moose migrate through the area from side canyons. Elk of the Jackson unit use the area primarily for migration. Bighorn sheep of the Targhee unit and mule deer from the Jackson unit use the area for spring, summer, and fall range. Mule deer from the Jackson Hole unit also use the area as critical winter range. Since most work would be conducted in late summer and early fall, conflicts with the winter migration should be minimal. If weather conditions are such that big game migrate early, then conditions (deep snow) may be such that construction activities would be halted. To avoid conflicts with migrating big game, work should cease by November 15, unless prior coordination with WGFD has taken place.

6.3.2.3 Other Mammals

Shrews (*Sorex* spp.) and voles (*Microtus* spp.) are common in riparian areas along the Snake River and its tributaries and would be expected to inhabit the environmental restoration project areas. Aquatic furbearers such as beaver (*Castor canadensis*), mink (*Mustella frenata*), and muskrat (*Ondatra zibethicus*) are commonly seen in streams, ponds, and backwater areas along the Snake River near Jackson, Wyoming. The levees are generally too rocky or exposed to provide habitat for either the beaver or muskrat. Beaver frequently construct dams in the Jackson Hole area (Corps 1994).

There are four mammal species (excluding Federally listed or candidate species) occurring in the Jackson Hole area that are tracked by the WYNDD table 6-4. The river otter (*Lutra canadensis*), a species considered rare in Wyoming, has been documented by the WYNDD. This species has been observed along the Snake River near logjams, pools, and oxbows that concentrate fish (Corps 1994). The hoary bat (*Lacers cinerus*), also considered rare in Wyoming, has been reported in the Jackson Hole area. Two other rare species, including the silver-haired bat (*Lasionycteris noctivagans*) and long-eared myotis (*Myotis evotis*), have been documented by the WYNDD in the Jackson Hole area. Wolverine (*Gulo gulo*) and lynx (*Felis lynx*) are also rare and occur in the region.

Small- and medium-sized mammals would be affected by disturbances associated with construction at environmental restoration project areas. Many of these species would avoid areas subject to disturbance; others would habituate. The river otter would likely temporarily avoid the environmental restoration project areas during construction but would not experience any long-term effects from disturbance.

6.3.2.4 Birds

The upper Snake River drainage provides habitat for a wide variety of resident and migratory birds, including waterfowl, raptors, and passerines. Approximately 150 different species have been observed, and 119 are documented or expected to breed in the area (Corps 1994).

The Corps would schedule construction activities at the environmental restoration project areas, which have critical waterfowl brood-rearing habitat, after nesting season to avoid impacts to nesting waterfowl and other birds. Construction at these sites would be scheduled after August 1 or 15 if bald eagle constraints apply (see paragraph 6.3.2.6.1). Resident birds and migrants (including several species considered rare in Wyoming) would be expected to temporarily avoid foraging or staging in areas subject to disturbance. No impacts to wintering birds, including the trumpeter swan, would be expected because construction activities for restoration would not occur at this time.

6.3.2.4.1 Waterfowl and Water Birds

The wetlands, ponds, backwater, and tributary creeks in the Snake River floodplain provide habitat for waterfowl and waterbird spring/fall staging, breeding, nesting, brood rearing, and wintering. The most prominent include Canada geese (*Branta canadensis*), trumpeter swans (*Cygnus buccinator*), and sandhill cranes (*Grus canadensis*); but common mergansers (*Mergus merganser*), mallards (*Anas platyrhynchos*), buffleheads (*Bucephala albeola*), and Barrow's goldeneyes (*B. islandica*) are also common seasonally. Frequently observed waterbirds include the American white pelican (*Pelecanus erythrorhynchos*), great blue heron (*Ardea herodias*), black-crowned night heron (*Nycticorax nycticorax*), western grebe (*Aechmophorus occidentalis*), and cormorant (*Phalacrocorax auritus*). Rarer migrants would include American bittern (*Botaurus lentiginosus*), black tern (*Chidonias niger*), Caspian tern (*Sterna caspia*) and Forster’s tern (*Sterna forsteri*), white-faced ibis (*Plegadis chihi*), Clark’s grebe (*Aechmophorus clarkii*), and snowy egret (*Egretta thula*). Long-billed curlew (*Numenius americanus*) and upland sandpiper (*Bartramia longicauda*) would be associated with the upland shrub-steppe habitat. They may be found along the river corridor foraging during migration.

Of the species listed above, only two would have a high potential for nesting/living in the work area: the black-crowned night heron and great blue heron. The ibis and snowy egret may be seen in wetland areas outside of the levee system during migration. Western and Clark’s grebes would be associated with the lakes and ponds in the region. The other species listed could live in the forest/woodlands adjacent to the river or migrate through the riverine system. Because work would be restricted to outside of the nesting season and removal of existing trees and shrubs would be avoided wherever possible, impacts to these species should be minimal or nonexistent.

On average (1982 through 1987), approximately 1,320 dabbling and 666 diving ducks winter on the river between Moose Junction and South Park (Corps 1994). Between Wilson and South Park Bridges, winter duck densities frequently average 139 per mile of river and tributary. This area is considered crucial winter waterfowl habitat (Corps 1994). Much of this same area is also considered crucial brood-rearing habitat (Corps 1994).

The harlequin duck (*Histrionicus histrionicus*), a candidate for Federal listing as threatened or endangered, is a species considered very rare in Wyoming and has been documented by the WYNDD in the Jackson Hole area (table 6-4). The common loon (*Gavin immer*), also rare in Wyoming and intensively managed, has been reported in the Jackson Hole area.

About 42 breeding pairs of Canada geese use the Snake River between the confluence of the Gros Ventre River and South Park Bridge. These consist of 22 pairs north of the Wilson Bridge and 20 pairs to the south (Corps 1994). The most important goose nesting areas include the confluence of the Gros Ventre River, the confluence of Blue Crane Creek, and between the confluence of the Spring Fork of Fish Creek and the confluence of Spring Fork of Spring Creek (Corps 1994). Stable islands with trees and logs that provide the cover necessary to reduce nesting losses from avian predation characterize these areas (Corps 1994). Areas 1, 4, and 10 are located near these nesting sites.

Brood-rearing habitat for Canada geese along the Snake River includes grazed meadows, ponds, gravel pits, and islands. The most important brood-rearing habitat is found in the following locations: (1) in wet meadows on the National Elk Refuge; (2) along the east side of the Snake River from the confluence of the Gros Ventre River to the Wilson Bridge; (3) the Snake River between Wilson and South Park Bridges; (4) the area between Fish Creek and the Snake River south of the landing strip; (5) South Park; and (6) about 2 miles of Flat Creek upstream from its confluence (Corps 1994). All environmental restoration project areas are within Canada goose brood-rearing habitat.

Between 1982 and 1988, the upper Snake River supported an average of 390 wintering Canada geese (Corps 1994). Wintering habitat is often limited by the lack of ice-free water. Crucial winter habitat includes: (1) nearly all of the river between the Wilson and South Park Bridges; (2) about half of the South Park area; (3) the area between Fish Creek and the Snake River south of the landing strip; and (4) about 2 miles of Flat Creek upstream from its confluence (Corps 1994). Other wintering areas include the river upstream of Wilson Bridge and two small off-river areas north of the bridge (Corps 1994). All of the environmental restoration project sites are within crucial Canada goose winter habitat.

The trumpeter swan is a candidate for Federal listing as threatened or endangered and is considered extremely rare in Wyoming. This species is intensively managed by the WGFD and is designated as sensitive by the USFS in the Jackson Hole area (table 6-4). In 1988, a total of 98 trumpeter swans wintered in the Jackson Valley, Grand Teton National Park, and the National Elk Refuge (Corps 1994). Trumpeter swan winter habitat in Wyoming, Idaho, and Montana appears to have the following characteristics (Corps 1994):

- soft substrate less than 2 inches deep;
- water less than 4 feet deep;
- channel greater than 50 feet wide;
- banks with no trees or shrubs;
- loafing sites with water less than 4 inches deep or sand/gravel bars in or near feeding areas;
- no physical barriers that bisect feeding or loafing areas or travel corridors;
- shallow water containing beds of diverse aquatic macrophytes that are available for at least 75 percent of the winter and not iced over for more than 2 or 3 days at a time; and
- water velocity in feeding areas that does not exceed 1 1/2 feet per second.

The Snake River, from the start of the Right Bank Federal Levee to just south of the Wilson Bridge, is considered potential wintering habitat for the trumpeter swan (Corps 1994). The river in this area is less than optimal for wintering swans because of the lack of calm water and absence of aquatic vegetation. Crucial winter habitat for trumpeter swans is provided by the following areas: (1) the Snake River downstream of the Wilson Bridge; (2) about half of the South Park area; (3) the area between Fish Creek and the Snake River south of the landing strip; and (4) about 1 mile of Flat Creek upstream from its confluence (Corps 1994). The Fish Creek, South Park area, and lower Flat Creek wintering areas received about 5,951 swan use days per year between 1982 and 1986 and 7 to 14 breeding pairs rely on these areas annually (Corps 1994). Fish Creek is the most heavily used of these areas and Flat Creek the least. Environmental restoration project Areas 1 and 4 south of Wilson Bridge are within crucial winter habitat for the trumpeter swan (Corps 1994).

There are several nesting pairs of trumpeter swans in the Jackson Hole area and there are at least three specific areas that are important for brood rearing (Corps 1994). None of the environmental restoration project areas are near trumpeter swan nests or brood-rearing locations.

Sandhill cranes nest in the upper Snake River drainage, primarily in beaver ponds and seasonally flooded emergent wetlands. This area supports between four and eight pairs of nesting cranes annually, but none are near the environmental restoration project areas (Corps 1994).

During spring migration, about 30- to 100-sandhill cranes use the meadows between South Park area and Spring Creek (Corps 1994). Area 1 is the only work site near this staging area.

The proposed work has the potential to impact some of these species. The timing of the work would minimize these impacts since breeding season will be coming to an end. Care will be needed to avoid impacting water birds, especially at Areas 1 and 4. Most of the birds would avoid the construction zones. Workers should take care not to injure or unduly harass water birds that may be found during construction activities.

6.3.2.4.2 Raptors

The upper Snake River and associated habitats support high numbers of fish and small mammals that provide prey for a variety of raptors. The most commonly observed raptors are the osprey (*Pandion haliaetus*), red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (B. *swainsonii*), and American kestrel (*Falco sparverius*). Other raptors known to occur in this area include ferruginous hawks (*Buteo regalis*), golden eagles (*Aquila chrysaetos*), western screech owls (*Otis kennicotii*), great horned owls (*Bubo virginianus*), and short-eared owls (*Asio flammeus*) (Corps 1994). Rarer hawks include the goshawk (*Accipiter gentilis*) and merlin (*Falco columbarius*). Most of these raptors nest in trees behind the levees.

Annually, three to four pairs of osprey nest along the Snake River in the Jackson Hole area, usually in partially or completely dead standing trees or artificial structures (Corps 1994). Approximately seven osprey nest sites have been documented along the Snake River between the beginning of the Left Bank Federal Levee and South Park Bridge (Corps 1994). All of the environmental restoration project areas are in the vicinity of these osprey nest sites. The osprey is considered rare or uncommon in Wyoming (table 6-4).

Two owl species tracked by the WYNDD (excluding Federally listed or candidate species) occur in the Jackson Hole area (table 6-4; Corps 1994). The flammulated owl (*Otis fammeolus*), considered extremely rare, and great gray owl (*Strix nebulosa*), considered very rare in Wyoming, have been seen in the vicinity of the Snake River downstream of the environmental restoration project areas.

Burrowing owls (*Athene cunicularia*) are found in the Wyoming. They migrate to the state primarily for breeding. They are associated primarily with prairie dog towns but will nest in the burrows of other mammals. It is highly unlikely that burrowing owls use the Jackson Hole area because of the lack of prairie dog towns and the short warm season. This type of habitat would not be found in the Snake River corridor so the environmental restoration work would not affect this species.

Raptors would avoid construction activities until they habituate to it. Workers should take care not to unduly harass raptors that might be found during work activities.

Removal of existing vegetation should be avoided wherever possible. Bald eagles are discussed in paragraph 6.3.2.6.

6.3.2.4.3 Other Birds

Other birds known to commonly occur in the Snake River floodplain near the Jackson Hole area include the loggerhead shrike (*Lanius ludovicianus*), black-backed woodpecker (*Picoides arctus*), killdeer (*Charadrius vociferus*), tree swallow (*Tachycineta bicolor*), yellow-headed blackbird (*Xanthocephalus xanthocephalus*), common nighthawk (*Chordeiles minor*), belted kingfisher (*Ceryle alcyon*), and Wilson's warbler (*Wilsonia pusilla*) (Corps 1994). These species and others would be expected to occur in the vicinity of the environmental restoration project areas. These species would face the same impacts as water birds and raptors.

6.3.2.5 Reptiles and Amphibians

Relatively little is known about amphibians and reptiles in the Jackson Hole area. Two frog species, the spotted frog (*Ranu pretiosa*), and northern leopard frog (*Ranu pipiens*); and one toad species, the boreal western toad (*Bufo bufo boreas*), considered very rare or rare in Wyoming, have been documented in the vicinity of the environmental restoration project areas (table 6-4). The sagebrush lizard (*Sceloporus graciosus*) and western terrestrial garter snake (*Thamnophis elegans*) are probably two of the most common reptiles in the area. The existing riparian vegetation within or near the environmental restoration work could have these species present. These species would be impacted if present within the side channels when construction activities are taking place. Most reptiles and amphibians would move from the area, but a few individuals may be injured or killed inadvertently. The timing of the work in late summer and fall would reduce these impacts.

6.3.2.6 Threatened and Endangered Species

The USFWS has documented five species in the Jackson Hole area that are classified as threatened or endangered. Endangered species observed in this area include the bald eagle (*Haliaeetus leucocephalus*), whooping crane (*Grus americana*), and peregrine falcon (*Falco peregrinus*). The Jackson Hole area is also within historical range for the grizzly bear (*Ursus arctos horribilis*), a threatened species, and gray wolf (*Canis lupus*), an endangered species (Corps 1994).

6.3.2.6.1 Bald Eagle

The upper Snake River drainage provides year-round habitat for bald eagles. Nesting usually occurs between February 1 and August 15. The Snake River population unit, which includes the Snake River in Wyoming, its tributaries, and Jackson Lake, consisted of 24 known breeding pairs in 1982 (Corps 1994). In 1992, seven active bald eagle nest sites existed between Moose and South Park Bridge, including one just downstream of Moose, one near the confluence of the Gros Ventre River, and five between the Wilson and South Park Bridges (Corps 1994). Between 1982 and 1989, the productivity of bald eagles nesting between Moose and the South Park Bridge averaged 1.47 young per nesting attempt, a number considered excellent (Corps 1994).

Bald eagles in the Jackson Hole area feed primarily on fish in the summer and waterfowl and carrion in the winter. Between 5 and 15 bald eagles have been observed during the winter along the Snake River between Moose and the South Park Bridge prior to 1994 (Corps 1994). This entire reach has been designated by WGFD as crucial wintering and nesting habitat (Corps 1994). All of the environmental restoration project areas are contained within this habitat.

In the past in Area 1, a bald eagle nest has been mapped toward the north end of the trees on the east side of the channel. No active nests were located in this area during 1998.

Bald eagles nested near Area 4 in 1998. Two active nests were located on the east side of the river. One nest was located about 2 1/2 to 3 miles south of the Wilson Bridge, 50 yards outside the levee. The second nest was about 1 1/2 miles south of the first nest, 3 to 4 hundred yards outside of the levee. Both nests were on private property.

Bald eagles nested near Area 9 in 1998. The nest was located on the west side of the river, outside of the levee, near human habitation.

Bald eagles nested near Area 10 in 1998. The nest was located in a grove of trees on the north side of the Gros Ventre River near the mouth. Both eagles were spotted during a tour of the area in 1998.

The CAR received from the USFWS (appendix B) stated, “No work activity within 1 mile of any active nests would occur between February 1 and August 15." For this reason, work would only be allowed within 1 mile of active nests (current year) between August 16 and January 31. Changes to this work window must have prior approval from the USFWS. No other constraints have been applied to nesting bald eagles. Since it is still unknown when work will actually commence, the environmental restoration project area would have to be surveyed for bald eagle nest each spring of the year when work is to be performed.

Because of the equipment access restrictions due to river flows, construction and excavation activities should not conflict with nesting. All standing mature trees in the work area would be avoided if at all possible. Trees that are leaning or already on the ground may be moved aside to facilitate excavation and construction. All of the known eagle nesting trees are currently located outside of the levee system. The biologist on site would work with the construction crew to avoid areas where equipment could damage mature trees.

Bald eagles would also be wintering in the area. The biologist on site would monitor for the presence of eagles and provide guidance to the work crews to avoid activities that might disturb the eagles. It is not anticipated that the work activity would cause additional disturbance to the eagles using the area beyond the human disturbance already occurring through normal recreational use.

Bald eagles are likely to be found in or near the work area most of the year. The chances of the environmental restoration project having any impact on the bald eagle are minimal due to the timing of the active work. There would likely be no direct impacts (mortality, loss of nest, *etc.*) or long-term population impacts (reduced reproduction, *etc*.). There may be some minor displacement of foraging or roosting eagles.

6.3.2.6.2 Peregrine Falcon

Until recently, the peregrine falcon was considered extirpated from Wyoming (Corps 1994). A recovery program was begun in 1980. Between 1980 and 1987, 153 peregrine falcons were released to hack sites (the term used for reintroduction sites) in Wyoming, primarily in Yellowstone National Park and in or near the National Elk Refuge. In 1986 and 1987, each year 25 peregrine falcons were released to 5 hack sites in Wyoming. One of these hack sites is located northwest of Wilson and another is on the National Elk Refuge. Approximately 80 to 83 percent of the released birds reached independence (Corps 1994).

The wetlands and streams along the Snake River south of Wilson Bridge support a variety of birds that are prey for peregrine falcons. This area is considered forage habitat for peregrine falcons and three to four adults and sub-adults have been observed in this region between 1982 and 1988 (Corps 1994).

In 1988, 6 nesting pairs of peregrine falcons in Wyoming produced 10 young (Corps 1994). In 1998, two eyries (nest sites) were located in the vicinity of the Grand Teton Mountains. Currently, one peregrine falcon forages in the South Park area near Fish Creek. This area is near the West side of Area 4.

Peregrine falcons are expected to leave the area soon after nesting is complete. The timing of nesting is similar to that of the bald eagle. They could be in the area any time between February and August. The biologist on site would monitor for the presence of peregrine falcons and provide guidance to the contractor to avoid activities that might disturb the peregrine falcons. Since the bulk of the environmental restoration work would occur after nesting season, the chance of the environmental restoration project impacting the foraging of peregrine falcons would be minimal.

6.3.2.6.3 Whooping Crane

The whooping crane is one of the rarest birds in North America. Reintroduction efforts at Gray's Lake National Wildlife Refuge in Idaho have resulted in whooping cranes occupying habitat in western Wyoming since 1977. In 1985, about 26 to 31 whooping cranes in the Gray's Lake population spent the summer in Wyoming. In 1988, only 16 of the Gray's Lake flock were still alive. Whooping cranes are occasionally sighted in the Jackson Hole area, primarily along the Gros Ventre River (Corps 1994).

Whooping cranes do migrate through the area of Jackson Lake during early spring. There is a chance a whooping crane may stop along the river in the Jackson Hole area, especially if sandhill cranes are using the area. The chances of a whooping crane stopping in the work area would be extremely rare. The whooping cranes would be attracted to wetland pastures and not the riverine corridor between the levees. The confluences of Blue Crane and Fish Creeks are the only two areas that might attract cranes. Areas 1 and 4 are within this region of the river. Most of the work would be taking place between August 15 and November 15. For these reasons, the environmental restoration project would have little or no impacts on the whooping crane population.

If a whooping crane is seen during work activities, work would cease. The WGFD and USFWS personnel would be contacted. Work would resume only after USFWS personnel have been consulted on how to proceed.

6.3.2.6.4 Grizzly Bear

The historical range of the grizzly bear once included most of Western North America. Currently, only six areas in the United States, including Yellowstone and Grand Teton National Parks, support self-sustaining grizzly bear populations (Corps 1994).

The grizzly bear is a resident species to the area, primarily north of the Jackson Hole area. Current management in Wyoming by WGFD is to discourage grizzly bears from living in areas of human habitation. The last sighting of grizzly bears in the Jackson Hole area was in 1994. An adult female with three cubs was captured near Area 4 and relocated to an area north of Jackson Hole. The female was attracted to the area because 15 cows, which were killed by lightning, were buried near the site. The biggest concern with this species is attracting them to the Jackson Hole area.

The chances a bear will be seen on site would be very rare, but precautions are needed since late summer/fall is the time of highest bear activity as they search for food in preparation for hibernation. Workers would be directed not to leave food and other garbage on site that may attract bears to the area. Some of these stipulations could include keeping the work site free of food and garbage and storing trash and food in approved containers. If a grizzly bear is seen during work activities, WGFD and USFWS personnel would be contacted. Since there is only a slight chance of encounters between grizzly bears and humans, the proposed work is unlikely to have an impact on the grizzly bear population.

6.3.2.6.5 Gray Wolf

The gray wolf historically inhabited all habitats in the Northern Hemisphere except tropical rain forests and deserts (Corps 1994). Currently, the largest populations of wolves in the lower 48 states occur in northern Minnesota. Remnant populations are believed to exist in Wyoming, Washington, Idaho, Montana, Michigan, and Wisconsin (Corps 1994). In the summer of 1992, a wolf was sighted in Yellowstone National Park, the first documented observation in over 20 years. Wolves have been sighted this year following the elk herds into the Jackson Hole area (WGFD 1998, USFWS 1998). Up until this year, there had been no sightings of wolves near Jackson, Wyoming. The wolves following the elk are unlikely to go near the town of Jackson. They would likely stay in the hills surrounding the elk refuge. The wolves avoid human activities including the construction work associated with this environmental restoration project. Like the grizzly, an effort should be made to avoid attracting wolves to human habitation. The same guidelines associated with grizzly bear management should be applied to gray wolves. This includes keeping the site clean of food debris and other garbage. If dead animals are found on or near the work site, they should be removed and disposed of properly. If a gray wolf is seen during work activities, WGFD and USFWS personnel would be contacted.

6.4 AIR QUALITY

Air quality in the Jackson Hole area is generally very good due to low population density, distance from major cities, and lack of large industrial sources of air pollution. The most significant sources of atmospheric emissions in the area are prescribed burns and wildfires. The Bridger-Teton National Forest includes areas in which fires are used to enhance wildlife habitat and to dispose of logging residues (personal communication, F. Kingwell, Forest Service, Bridger-Teton National Forest, Jackson, Wyoming, March 10, 1989/Jackson Hole Flood Protection, Levee Access Improvements, Draft Environmental Assessment, November 1994, Corps). There are no major point sources of air pollution in the area. Consequently, the most significant emission sources are forest fires, automobiles, and residential wood-burning stoves (personal communication, B. Daily, Wyoming Department of Environmental Quality (DEQ), Cheyenne, Wyoming, April 7, 1993/Jackson Hole Flood Protection, Levee Access Improvements, Draft Environmental Assessment, November 1994). Based on current information, ambient air quality standards in Jackson are not being exceeded (personal communication, L. Gribovicz, Wyoming DEQ, Lander, Wyoming, September 16, 1998).

The operation of trucks and other equipment that generate emissions would only occur during the brief fall work window. Construction would occur at only one of the environmental restoration project areas per work season; therefore, emissions would not be generated at all four areas simultaneously. Increases in emissions from equipment operation at any one of the environmental restoration project areas are expected to be minimal, of short duration, and are not expected to result in a detectable level beyond those currently generated in the Jackson Hole area. Based on this, air quality impacts from emissions are expected to be short-term and negligible. Emissions would not result in any long-term, permanent impacts upon air quality.

Trucks traveling on unpaved roadways may generate dust while transporting supplies and materials. Dust may also become airborne from equipment operation on the gravel bars and levees. Virtually all of the unpaved roads are remotely located; therefore, impacts from fugitive dust along the roadways are expected to be minimal. Negligible amounts of dust are expected to be generated from operation of equipment on gravel deposits between the levees. To minimize the potential for fugitive dust, speed limits for operation of equipment on the gravel bars and upon the levees may be necessary. Because the levees are constructed primarily of rock, only minor concentrations of fugitive dust are expected to be generated by the operation of trucks on the levees. Based on the imposition of speed limits for equipment and minimal potential for generation of dust on the levees, impacts from the generation of dust by equipment operation on gravel bars, roads, and levees are expected to be minimal. No long-term, permanent impacts would occur from fugitive dust.

The generation of dust by cobble screening activities is also expected to be negligible or nonexistent due to the moisture content of the material being screened. Recreational users may experience dust when passing through the immediate vicinity of the screening operation; however, the impact would be of short duration. Overall, any air quality impacts that might occur as a result of cobble screening are expected to be negligible and of short duration.

6.5 LAND USE

Land use in Teton County is heavily influenced by landownership patterns. Federal land in the county is used primarily for recreation, wilderness, wildlife management, and forestry. Private land is primarily classified as agricultural, although the use of land for agricultural purposes has diminished over the years (U.S. Bureau of the Census 1989 and Jackson Hole Flood Protection, Levee Access Improvements, Draft Environmental Assessment, November 1994). Over the past few decades, land previously classified as agricultural has been converted to residential and other nonagricultural uses.

The Federal government is the largest landowner (97 percent) in the 4,000 square miles of Teton County. The USFS administers most of the Federal lands in three national forests within the county, which together comprise approximately 77 percent of the land in the county. Of the three national forests, the Bridger-Teton National Forest has approximately 1,096,000 acres, the most in the county. Other Federal agencies that manage land within Teton County include the National Park Service, which administers Grand Teton National Park (310,000 acres); the USFWS, which manages the National Elk Refuge (approximately 24,000 acres); the Bureau of Reclamation, which manages Jackson Lake Dam; and the Bureau of Land Management (BLM), which manages approximately 9,000 acres, primarily near the Snake River (Jackson Hole Flood Protection, Levee Access Improvements, Draft Environmental Assessment, November 1994).

Lands within the three national forests in the county are managed for timber production, recreation, wildlife habitat, and wilderness. At Grand Teton National Park, land use is conservation and recreation oriented. National Elk Refuge land is maintained as wildlife habitat. The BLM leases land for grazing and manages some land within Teton County for recreation (primarily near the Snake River).

The State of Wyoming owns approximately 10,000 acres in the county as either school trust lands or resource lands. The WGFD manages 2,000 acres of State-owned land primarily as wildlife habitat but allows some camping. State trust lands comprise approximately 8,000 acres in Teton County of which approximately 1,900 acres are leased to the WGFD; 5,000 acres are leased to grazing and agricultural uses; and the remaining acres are not leased (personal communication, D. Force, Wyoming State Land Farm Loan Office, Cheyenne, Wyoming, August 31, 1992, and Jackson Hole Flood Protection, Levee Access Improvements, Draft Environmental Assessment, November 1994).

Private property accounts for approximately 3 percent (75,000 acres) of Teton County. Of the privately owned land, approximately 1,160 acres are contained within the town of Jackson corporate limits. The size of privately-owned parcels varies from small in-city lots to farms and ranches over 2,000 acres.

Privately owned lands in the county are concentrated on the valley floor of Jackson Hole south of Grand Teton National Park, an area approximately 20 miles long and up to 10 miles wide. There are 160 acres of private holdings within the National Elk Refuge (personal communication, M. Hedrick, Refuge Manager, USFWS, Jackson, Wyoming, August 27, 1992/Jackson Hole Flood Protection, Levee Access Improvements, Draft Environmental Assessment, November 1994). There are significant areas of private holdings in Grand Teton National Park. Most of the private lands within Jackson Hole have not been intensively developed, although there has been rural-to-urban land conversion over approximately the past 3 decades. Ranching has declined considerably as an economic activity, but much of the former ranch land remains mainly in agricultural or woodland use. The vast majority of private land in Teton County has been classified as agricultural land in the past and continues to be. In 1954, there were 98 farms in Teton County comprising 72,724 acres. The U.S. Bureau of the Census 1989 reported 110 farms with a total of 72,197 acres within the county in 1987 (Jackson Hole Flood Protection, Levee Access Improvements, Draft Environmental Assessment, November 1994).

This proposed environmental restoration project would occur upon privately owned lands and lands administered by the BLM. Lands would be altered through the removal of gravel and placement of materials to construct the environmental restoration tools. These alterations, however, would not eliminate any current land uses identified above or introduce any new land uses. The local sponsor would obtain real estate instruments, which the sponsor identifies in their real estate report as being necessary for implementation of environmental restoration work on Federal and private lands.

6.6 TRANSPORTATION

Several highway routes provide year-round transportation in the vicinity of the environmental restoration project. The primary route used by north and southbound traffic is U.S. Highway 26. The highway enters the Jackson Hole area from the northeast, continues through the valley and the community of Jackson, Wyoming, and exits the valley to the south. Wyoming State Highway 22 starts on the west side of Jackson, crosses the Snake River at the Wilson Bridge, and continues west over Teton Pass. Wyoming State Highway 390 extends north from its intersection with State Highway 22 near Wilson Bridge and is a primary route used by north and southbound traffic on the west side of the valley. Several secondary roads also provide access in and around the project area. These include, but are not limited to, South Park Loop, Fall Creek Road, and Spring Gultch Road. Various unnamed private roads exist in and around the project area.

Impacts upon transportation would occur as a result of construction of the environmental restoration project and subsequent performance of work to maintain the structures. Both construction and maintenance would require similar measures to implement. However, maintenance would likely involve less effort than actual construction; therefore, potential impacts from maintenance should be less than those of construction activities.

The transport of construction materials and supplies to the four project areas would increase truck traffic on primary highway routes and secondary roads. Trip repetitions for this type of traffic would generally be limited; therefore, any impact upon traffic patterns from this particular truck activity is expected to be minimal.

The ingress and egress of gravel trucks between gravel screening sites and upland disposal areas at existing gravel processing facilities would likely generate the greatest traffic increase on primary and secondary roads. Because the quantity of gravel that may be transported would reasonably vary from site to site and from year to year, establishment of an estimate for the number of repetitions necessary to perform construction and maintenance is difficult. It is reasonable to expect peaks in truck traffic that would add to or create traffic congestion. Conflicts may exist between contractors performing maintenance of the Jackson Hole Flood Control Project and contractors constructing the environmental restoration project. The

Corps would address such conflicts that occur on the Jackson Hole Flood Control Project access roads and levees. The local sponsor would identify any transportation conflicts on public roads and implement traffic control measures (such as flaggers or signage) at locations that experience more than minimal increases in traffic congestion. Operation of loaded trucks on the Jackson Hole Flood Control Project levees and access roads during construction and maintenance would likely cause impacts to the surface of these structures. The Corps would ensure repair of such surface impacts resulting from construction. The local sponsor would be responsible for repairs to the surface resulting from their post-construction maintenance activities. Because surface repairs would be implemented, impacts upon the access roads and levees would be temporary.

Staging areas for fuel and lubricant storage and dispensing would be located outside of the leveed sections of the Snake River. Staging outside the levees would dramatically decrease the potential for unintentional releases of toxic materials into the Snake River. A minimum of one staging area would be necessary at each of the four work areas. Staging areas would be selected and any easements, licenses, or permits necessary for staging areas would be acquired by the local sponsor. The contractor and any subcontractors would be required to submit for approval, prior to initiation of construction, a hazardous materials spill and cleanup plan including tools and materials that would be on hand and readily available to facilitate containment and cleanup. All overnight equipment storage, as well as refueling and maintenance activities, would be restricted to staging areas. Based upon the above measures, no more than minimal, short-term impacts upon transportation are expected from either maintenance or construction of the environmental restoration project.

Access to work areas would occur primarily upon the roadways identified below, in addition to other unnamed roadways. Access would generally originate from public roadways and may use roadways already under easement for access to the levees for the purpose of performing operation and maintenance activities. Real estate instruments necessary for access will be identified in the local sponsor’s real estate report. The local sponsor would coordinate acquisition of necessary real estate instruments.

The roads for the levee access easements are typically dirt roads and are suitable for moving construction equipment. Flows in the Snake River are too high to allow for construction access from only one side of the river so access from both sides of the river would be necessary. The contractor would coordinate with the Corps’ biologist, representative for the flood control project, and the landowner (in the field) to determine the optimum access routes for minimizing disturbances. The east and west access points for each of the 4 areas is described below.

6.6.1 Area 1 East Access

The east portion of Area 1 would be accessed from the north from South Park Loop along a 1-mile stretch of gravel road to the Lower Imenson Levee. Once on the levee, construction equipment would follow the levee until it terminates. After the levee ends, access would continue through existing shrubs and trees and over gravel bars.

6.6.2 Area 1 West Access

The west portion of Area 1 would be accessed from Fall Creek Road and involves two different access points. The first access point is for the downstream work area. The access originates off of Fall Creek Road and follows a dirt road to the Sewell Levee. It would then continue along the Sewell Levee to the work area. The access to the upstream work area would also originate from Fall Creek Road and would follow a dirt road to the work area.

6.6.3 Area 4 East Access

The east portion of Area 4 would be accessed from the Federal Levee Extension. Construction equipment would leave the public highway, approximately 4 miles to the north and follow the left bank of the Federal Levee Extension to the work area.

6.6.4 Area 4 West Access

Access to Area 4 would be from Fall Creek Road along an existing gravel road. This access crosses an existing bridge and terminates at the channel bottom. The contractor may need to navigate across gravel bars and around existing vegetation.

6.6.5 Area 9 East Access

Access to the east portion of Area 9 would be from State Highway 22, which provides access to the Left Bank Federal Levee. From the Left Bank Federal Levee, an access point to the specific work areas would be selected in the field.

6.6.6 Area 9 West Access

Area 9 is the most accessible of the four areas. Access for the west portion of Area 9 would originate from State Highway 390. From State Highway 390, the contractors would follow an existing dirt road to the Right Bank Federal Levee.

6.6.7 Area 10 East Access

The work on the east portion of Area 10 would be reached from the downstream direction or the upstream direction. From the downstream direction, equipment would travel from State Highway 22 and then up the Left Bank Federal Levee for approximately 3 miles to the work areas. From the upstream direction, equipment would travel from Cattleman's Bridge, which is approximately 2 miles away, to the Hanson Levee. The spur dikes located to the north would be accessed from Spring Gultch Road, which is about 2 miles away.

6.6.8 Area 10 West Access

Most of the work in Area 10 lies to the west of the river and would be accessed via the Right Bank Federal Levee. From the levee, construction equipment would traverse existing gravel bars and around or through vegetated areas to the specific work areas. Equipment could reach the levee from both the upstream and downstream directions. The downstream end of the levee would be accessed from a dirt road that runs for about three-fourths of a mile from State Highway 390 to the Right Bank Federal Levee.

6.7 SOCIO-ECONOMICS

The Snake River and its tributaries have been an important resource in the economic and social development of the Jackson Hole area. A study of the economic importance of fishing to Jackson Hole is in effect a study of two of the states most outstanding resources: (1) the Snake River and its system of associated smaller rivers and creeks, and (2) the cutthroat trout. The decision to "go fishing" creates demands for goods and services.

The Jackson Hole area has become the summer home and vacation home destination for a number of families since 1970. Expenditures by these families in the Jackson Hole area, like tourist expenditures, represent a new demand for goods and services and a flow of new money into the local economy.

A Chamber of Commerce study (1985) was targeted at tourists visiting the area regardless of whether the party was from out-of-state or from another county in Wyoming. The results of this study indicated that the direct fishing related expenditures of $6,967,000 brought nearly $61,000,000 of "new money" into the area. The $61,000,000 total output relates to the direct, indirect (related industry output), and induced spending (household spending generated from the direct and indirect industry spending). This concept is called the "multiplier effect." The multiplier in this case is 8.9. This means that every dollar of direct spending generates $8.90 of total output throughout the local economy. Examples of related output may be local motel, eating establishments, and any other incidental expenditures the nonlocal may make while recreating and fishing in the area.

Translating these 1985 base numbers into current 1998 price levels using local inflation rate of 6.8 percent per year yields the following results. Direct fishing related expenditures at 1998 price levels are expected to be $16,386,000 [1985-1998 = 13 years @ 6.8 percent per year inflation (includes both money inflation of

4.05 percent and population growth of 2.7 percent) with gross receipts of $143,300,000 in local related industries].

The Jackson Hole, Wyoming, Environmental Restoration Project, studies four sites along the Snake River that are expected to yield the most benefit to the riparian and aquatic habitat. Assuming all four site alternatives are implemented and comparing the resulting benefits in aquatic and riparian habitat units, the Corps speculates that over the 50-year project period average annual fish numbers (cutthroat trout and other species) will help maintain their present population. Without the environmental restoration project, aquatic and riparian habitat will be expected to decline over the next 50 years.

The environmental restoration project, by improving the aquatic and riparian habitat, is also expected to enhance the aesthetics of the area to visiting sports persons and tourists, in general, regardless of their objectives in visiting the Jackson Hole area. By increasing the amount of vegetation in some areas, people may have a better experience when they go fishing. Most fishermen probably would rather see trees and other vegetation than bare cobble and gravel.

Local jobs maintained by the $143,000,000 output related to sportsfishing, accounts for about 25 percent of the total employment of Teton County. This is based on statistics furnished by the Jackson Hole Economic Development Council web site. Local nonfarm sales in 1997 were estimated at $583,000,000 based on sales tax receipts of $35,000,000 in this sector. The sales tax rate of 6 percent would indicate gross sales of $583,000,000. Approximately 18,500 workers generated this $583,000,000 in sales. This allows each worker to generate $31,600 sales per year. If the $143,000,000 sportsfishing output and sales is maintained, 4,500 jobs would be enhanced in the area. No consideration was given to the cost of each option since those numbers are not available at this time.

6.8 RECREATION

The Snake River in the vicinity of the four project areas principally experiences recreational use from rafting and fishing. Some waterfowl hunting also occurs on the river. Levees along the four project areas are used for a variety of recreational purposes including walking, hiking, jogging, bicycling, cross country skiing, horseback riding, bird watching, nature viewing, picnicking, and other similar uses. The levees also provide access for direct river use such as fishing and waterfowl hunting.

The majority of recreational use for the four project areas occurs near the Highway 22 Bridge (Area 9), also known as the Wilson Bridge. Recreational use at this site occurs year-round, with high use continuing into November. South Park Elk Feed Grounds receives limited public recreational use, most of which occurs during summer as hiking and nature viewing (personal communication, Tim Young, Jackson Hole Community Pathways, November 1998). The southwest levee at

Wilson Bridge experiences considerable use. The northwest levee gets only limited use while the southeast levee does not get any use. The northeast levee gets a lot of use due to the close proximity of a park (personal communication, Franz Carmindzend, Jackson Hole Alliance, October 1998).

A 1990 report filed by the WGFD, Jackson Field Office, indicated that during the summer months, the Wilson Bridge site experienced 2,313 user days by fishermen using the upper stretch and 1,804 user days on the lower end. A precise count for 1998 is not currently available. It is likely the area experiences the same or slightly higher levels of use than 1990.

Camping on islands and on shore sites is prohibited by the settlement of a lawsuit between the BLM and landowners. With the landowners in control of how the land is used in the proposed project reach, many recreational restrictions exist. Camping is one of the recreational uses that is prohibited in all but one or two sites. These sites are very rarely used.

The proposed action has the potential for both short-term and long-term impacts upon recreational uses. Recreational use could potentially be affected by construction, impacts from the presence of completed structures, and impacts from structure maintenance.

The effects of construction activity would occur principally in the form of short-term impacts. These impacts would occur during ingress and egress of equipment to the work sites and during actual on-site construction. Access to the work sites would occur over a variety of routes and for a variety of purposes. Access would be necessary to transport equipment, materials, and supplies to and from the work sites. Some routes would require use of levees and others would not. Of the levees that would be used for ingress and egress, some receive recreational use and others do not. Those that receive recreational use have the potential for user conflicts to develop.

Use of the Sewell and Lower Imenson Levees would be necessary to access Area 1. The public does not have access to either of these levees. The Federal Levee Extension would be used to access the east side of Area 4. There is no public access to the Federal Levee Extension at the east side of Area 4. The Right Bank Federal Levee would be used to access the west side and the Left Bank Federal Levee used to access the east side of Area 9. Access to reach the Left Bank Federal Levee on the east side at Area 9 would be through an existing conservation park used by recreationists. Access to the Right Bank Federal Levee at Area 9 would occur upon an existing unpaved road leading to a boat launch and parking area. The public has access to both the Right and Left Bank Federal Levees at Area 9. Area 10 would be accessed via the Right Bank Federal Levee on the west and the Left Bank Federal and Hanson Levees on the east. There is no public access to levees at Area 10.

Operation of equipment upon levees accessible to the public would create a conflict for persons hiking or walking the levee. As indicated above, traffic control measures, such as flaggers or signage, would be used at locations that would experience more than minimal conflicts between recreationists and construction-related activity. Such situations would be identified and resolution measures implemented by the local sponsor. Impacts from construction-related activity upon levee users would be temporary and would be minimized through the use of measures referenced above.

Gravel removal to maintain channel capacity and construct channel stabilization pools would occur in areas of the primary river channel. In-channel work may also involve construction of temporary water diversions or berms to reroute flows and de-water gravel removal sites. Spur dikes would be constructed adjacent to levees where the high-velocity flows of the primary channel occur. Rafters and float fishermen would be the primary recreationists likely to be affected by the in-channel work. Fishermen fishing from the bank or wading would be less affected. The primary effect upon rafters and float fishermen would occur from the temporary alternation of the primary channel flow. The proposed gravel removal would have only a minor effect upon rafters and float fishermen.

Presence of completed eco fences, channel stabilization pools, anchored root wad logs, and spur dikes would change the configuration of the river channel and effect flow patterns. Eco fences, anchored root wad logs, and spur dikes would result in more permanent changes to the channel than would the channel stabilization pools. Channel stabilization pools would trap bedload materials, therefore, would become less prominent over time. However, maintenance of the channel stabilization pools after they have filled with bedload material would result in renewed changes in configuration and flows.

Permanent changes in the channel are expected to have long-term, yet minimal impacts upon rafters and float fishermen. Rafters would have to become accustomed to the new configuration and flows resulting from spur dikes, anchored root wad logs, and eco fences. Because these structures would not be in the middle of the primary flow, rafters and float fishermen should have little difficulty negotiating or bypassing the structures. The effort required for rafters and float fishermen to learn the new changes are expected to be no greater than is required each year after seasonal high flows. The permanent changes in configuration and flow would not de-water the channel or restrict access. The permanent changes have considerable potential to provide long-term benefits to recreational users through the creation of additional fish habitat.

If structures are damaged by high flows, parts of structures, such as cables from eco fences, could pose a hazard to rafters and float fishermen. To alert river users to the presence of the new structures, the local sponsor would implement a public information campaign and perform monitoring and maintenance to identify potentially unsafe structure conditions.

Gravel removal to maintain channel capacity and construct channel stabilization pools is expected to have even less impact on recreationists than the eco fences, channel stabilization pools, anchored root wad logs, and spur dikes. Channel stabilization pools would cause slower flows, creating a pool effect, therefore, would not pose as a hazard or barrier to floaters. This change is not expected to have more than a minimal effect on rafters and float fishermen. Floaters and rafters would likely experience improved floating conditions due to stabilization of the channel. Overall, the permanent, long-term effects upon recreation resulting from the presence of the completed structures are expected to be minor.

The effects of maintenance upon recreation activities would be similar to those resulting from construction. However, work required to perform maintenance is reasonably expected to be less than would be required to actually construct the environmental restoration project. Primary effects would result from ingress and egress of equipment and actual construction activity and would be short-term.

Levees at Area 9 actively being used in support of construction would be clearly signed at all access points to alert users to the presence of trucks and other equipment. Because the greatest use by recreationists occurs on the Left and Right Bank Federal Levees upstream of the Wilson Bridge at Area 9, the greatest inconvenience upon recreationists would likely occur at these locations.

A flagger would be posted, when necessary, at the Area 9 boat ramp to coordinate use between recreationists and construction equipment using the site for ingress and egress to construction areas.

A public information campaign would be implemented by the local sponsor to inform the recreating public about the environmental restoration project and possible conflicts between recreationists and construction activities. The campaign would include installation of appropriate signage at all levee access points and at the ramp and conservation park at Area 9. An information brochure would be prepared and distributed by the local sponsor to all fishing and rafting outfitters as well as placed at information boards at public access areas. Other sources available to the local sponsor for distributing information to the public may include the print media and radio. The campaign would be implemented both prior to and during construction.

6.9 AESTHETICS

The proposed environmental restoration project would occur within the Snake River between the levees near the Jackson Hole, Wyoming, area. The Jackson Hole area is popular as a year-around recreation destination. The area’s spectacular scenery is of national significance, as evidenced by the establishment of the Grand Teton National Park in 1929.

The proposed environmental restoration project areas are located in the outwash plain of the Snake River. The river channel is relatively wide and braided with extensive areas of gravel bars. Riparian vegetation is found along many of the channels. Stands of trees, composed primarily of cottonwoods, willow, and alder are scattered throughout the outwash plain.

Views of the floodplain, by boaters and other recreationists using the Snake River, are generally restricted because of adjacent riverbanks, levees, and vegetation. The primary views along the rivers are of the mountains, particularly the Grand Teton Mountains, which can be viewed beyond the riverbanks and levees in locations where there are openings in the riparian vegetation.

Within the past few years, Area 1 has undergone extensive lateral erosion due to the “fire hose” effect of concentrated river flows emerging from the confined channel upstream. The installation of eco fences and anchored root wads would help to reestablish island vegetation as well as help protect existing islands and encourage growth of new islands.

The vegetation at Area 4 is predominately shrub-willow. Most of the existing islands currently within the channel are devoid of vegetation due to island instability and changing river flows. The installation of eco fences and anchored root wad logs would help reestablish island vegetation.

The river at Area 9 is somewhat restricted and the islands are devoid of vegetation. The vegetation along the shoreline is predominantly shrub-willow. Rock grade control structures would be constructed flush with the existing channel bottom and would help prevent bank erosion and degradation of existing habitat. Eco fences and anchored root wad logs would assist in revegetation of existing islands and establishment of new islands. Spur dikes would be used to provide bank protection and enhance fisheries habitat by creating flow diversity and enhancing pools, fish resting areas and riffles, thus improving the visual quality of the riverbanks.

Area 10 is located at the confluence of the Gros Ventre and Snake Rivers. This area has extensive cottonwood vegetation on existing islands and along the shoreline. Eco fences and anchored root wad logs would assist in promoting a more diverse vegetative cover along existing shorelines and encourage the growth of new islands. Spur dikes would enhance fish habitat and provide additional bank protection. This would allow regeneration of native plants as well as improve the visual quality of the riverbanks.

The removal of gravel to maintain channel capacity and construct channel stabilization pools and the presence of the anchored root wad logs, eco fences, off-channel pools, and secondary channels are not expected to contrast sharply with the existing surroundings. The proposed measures are expected to create long-term potential for restoring aquatic and terrestrial habitat along the environmental restoration project area. Over time, with the reestablishment of islands and vegetation, the aesthetics of the project area would improve.

6.10 CULTURAL RESOURCES

The area of the proposed environmental restoration project includes floodplain areas between the levees along the Snake River. This area is part of the glacial outwash plain that forms the floor of the area referred to as Jackson Hole. The surface has been modified by fluvial deposition and erosion caused by the Snake River and its tributaries. Soils are generally deep, loamy soil types with a high proportion of rock fragments. Stream crossing locations typically exhibit river cobbles or gravel with some sandy soil cover. The valley floor is interrupted in places by ridges and buttes, formed by remnant volcanic and intrusive rocks.

A Class 2 reconnaissance survey was performed within the generalized environmental restoration project areas during the period August 12 to 16, 1996, by the Walla Walla District's staff archaeologist. Record searches were also conducted. No previously unrecorded cultural properties were found during the reconnaissance survey. Record searches identified two previously recorded sites close to two of the proposed environmental restoration project areas but outside of the levees.

Because the previously recorded sites are located outside of the levees, away from where the proposed actions would occur, the Corps determined the environmental restoration project would have no effect on any previously listed cultural property. The Corps also determined the potential for the occurrence of any unrecorded cultural properties in the areas of impact to be low.

A copy of the Corps' Survey Report was forwarded to the Wyoming Division of Cultural Resources, State Historic Preservation Office (SHPO), for review and concurrence. In their letter of February 12, 1997, the SHPO responded that no sites meeting the criteria of eligibility for the National Register of Historic Places would be affected by the environmental restoration project. The SHPO recommended the project proceed in accordance with state and Federal laws, subject to the following stipulation: "If any cultural materials are discovered during construction, work in the area should halt immediately and the Corps and SHPO staff must be contacted. Work in the area may not resume until the materials have been evaluated and adequate measures for their protection have been taken." Refer to appendix D for the SHPO letter concurring with the Corps' determination of "no effect."

6.11 CUMULATIVE EFFECTS

The Flood Control Act of 1950 authorized flood protection by levees and revetment along the Snake River in the Jackson Hole, Wyoming, area. The project was completed in the fall of 1964. Levees have been added to the system by other agencies and by "emergency flood fight" operations of the Corps and Teton County through 1997. The effect of these measures has been the alteration of the physical character of the river, both inside and outside of the levees, along approximately 25 miles between Moose Bridge and South Park Elk Feed Grounds. Presently, the width of the Snake River floodplain is reduced by the levees, flow velocities through the leveed sections are increased, elevated quantities of bedload material is transported through the area, and island and associated vegetation is eroding. Water flows to spring creeks outside of the levees have been reduced. Spawning habitat for cutthroat trout has been reduced or destroyed and the composition and quality of riparian vegetation outside of the levees is changing.

During the winter of 1998-99, Teton County coordinated a demonstration project within this same stretch of river near the Wilson Bridge. Approximately 6,000 cubic yards of cobble and gravel were excavated to construct three off-channel pools. Approximately 1,600 linear feet of channel was excavated to maintain flow capacity within 100-year event flows. Five-pile eco fences totaling approximately 500 linear feet were also constructed. The purpose of the demonstration project was to implement measures to counteract the adverse resource effects of the existing levees and revetment. Effects of the demonstration project would be the long-term improvement of water quality, stabilization of the channel, and establishment of aquatic and terrestrial habitat.

During the same period, Teton County also constructed a kicker along the left bank of the river just above the Wilson Bridge to diminish effects of flows on the levee. This work was conducted in accordance with a Local Cooperation Agreement signed by the Corps and Teton County in September 1990 for the performance of levee maintenance. Teton County conducts annual operations to maintain the levees; however, the maintenance operations do not increase or expand effects to the existing levees and revetment on the Snake River.

The environmental restoration measures being proposed under the Jackson Hole, Environmental Restoration Project, would have both short- and long-term effects on the Snake River. Environmental restoration measures proposed for Area 1 include excavation of a single channel stabilization pool and four off-channel pools with connecting upstream and downstream secondary channels, construction of eco fences, and placement of anchored root wad logs. Construction would result in minor, nonbeneficial short-term impacts to water quality, air quality, aesthetics, recreation, aquatic and terrestrial species and habitat, and local transportation. Presence of the completed structures would have long-term beneficial effects upon water quality, recreation, and aquatic and terrestrial species and habitat. The changes attributable to the collective effect of actions proposed for Area 1 would decrease nonbeneficial effects of past flood control activities and cause an overall net increase in beneficial effects in the long-term. There would be no measurable increase in the baseline detrimental effects caused by previous flood control activities.

Environmental restoration measures in Area 4 would include: excavation of two channel stabilization pools and three off-channel pools with connecting upstream and downstream secondary channels; construction of eco fences and spur dikes; placement of anchored root wad logs; and removal of gravel to maintain channel flow capacity within 100-year event flows. Construction would result in minor, non-beneficial short-term impacts to water quality, air quality, aesthetics, recreation, aquatic and terrestrial species and habitat, and local transportation. The completed structures would cause long-term beneficial effects upon water quality, recreation, and aquatic and terrestrial species and habitat by stabilizing the channel and allowing recovery of aquatic and terrestrial habitat. Actions proposed in Area 4 would not add to the cumulative adverse effects caused by previous flood control actions at Area 4.

Environmental restoration measures in Area 9 would include: construction of eco fences, placement of anchored root wad logs, and removal of gravel to maintain channel flow capacity within 100-year event flows. Construction would result in minor, nonbeneficial short-term impacts to water quality, air quality, aesthetics, recreation, aquatic and terrestrial species and habitat, and local transportation. Presence of the completed structures in Area 9 would result in long-term beneficial effects upon water quality, recreation, and aquatic and terrestrial species and habitat. The changes attributable to the collective effect of actions proposed for Area 9 would decrease nonbeneficial effects of past flood control activities and cause an overall net increase in beneficial effects in the long-term. No measurable increases in the net detrimental effects caused by previous flood control activities would occur.

Environmental restoration measures in Area 10 would involve excavation of a single channel stabilization pool and two off-channel pools with connecting upstream and downstream secondary channels, construction of eco fences, placement of anchored root wad logs, and removal of gravel to maintain channel flow capacity within 100-year event flows. Construction in Area 10 would also cause minor, nonbeneficial short-term impacts to water quality, air quality, aesthetics, recreation, aquatic and terrestrial species and habitat, and local transportation. Water quality, recreation and aquatic and terrestrial habitat would benefit in the long-term from the presence of the completed structures. Changes caused by the cumulative effect of actions proposed for Area 10 would cause the nonbeneficial effects from past flood control activities to diminish. In the long-term, an overall net beneficial increase in aquatic and terrestrial habitat would occur.

The cumulative effect of past and proposed actions along the Snake River would not cause additional reduction in the width of the floodplain, increase flow velocities through the levied areas, increase transport of bedload material, destabilize the channel, erode islands and vegetation between the levees, or diminished flows to spring creeks outside of the levees. The cumulative effect of the proposed environmental restoration project would be improved water quality through reduced velocities and stabilization of the channel, reduced erosion of islands and loss of vegetation, opportunity for the reestablishment of islands and vegetation, and creation of additional habitat for cutthroat trout and other aquatic and terrestrial species.

7.0 COMPLIANCE WITH ENVIRONMENTAL PROTECTION STATUTES AND REGULATIONS

The following paragraphs address the principal environmental review and consultation requirements applicable to this environmental restoration project. Pertinent Federal statutes, executive orders, and state permits are included.

7.1 FEDERAL STATUTES

7.1.1 National Historic Preservation Act, As Amended; Executive Order 11593, Protection and Enhancement of the Cultural Environment, May 13, 1971

The proposed action was evaluated for compliance with the above Act and Executive Order; and a report was coordinated with the Wyoming Department of Cultural Resources, SHPO. The SHPO concurred that no sites meeting the criteria of eligibility for the National Register of Historic Places would be affected by the proposed action. This environmental restoration project would, therefore, be in compliance with the Act and the Executive Order.

7.1.2 Clean Air Act, As Amended

Construction activities would result in only minor, short-term exhaust emission from construction equipment. Fugitive dust from this environmental restoration project would also be minimal. This project would be in compliance with the Clean Air Act.

7.1.3 Clean Water Act

Section 404 of the Clean Water Act [33 United States Code 1344] requires evaluation of activities involving discharges of dredged or fill material into waters of the United States, including wetlands. The 404(b)(1) Guidelines [40 Code of Federal Regulations (CFR) Part 230] are the substantive criteria used in evaluating discharges of dredged or fill material under the Act. The Corps has prepared an evaluation (appendix E) of discharges associated with the environmental restoration project, in accordance with the Guidelines. The evaluation will be used to solicit water quality certification from the State of Wyoming, DEQ. The Corps would not initiate discharges in the Snake River until the environmental restoration project has been certified or conditionally certified.

7.1.4 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act of 1958 (Public Law 85-624) requires that when the water of a stream or other body of water are proposed to be impounded, diverted, channel deepened, or stream or other body of water otherwise controlled or modified for any purpose, the USFWS be consulted. The USFWS was tasked with writing a CAR. The CAR was completed, reviewed by the Corps, and finalized on

October 27, 1998. See appendix B. This environmental restoration project is in compliance with the Act.

7.1.5 Endangered Species Act of 1973, As Amended

A list of threatened or endangered species that might occur in the vicinity of the environmental restoration project was obtained from the USFWS. The Corps prepared a BA of potential effects of the project upon the listed species. In their letter of November 30, 1998, the USFWS responded that the project may affect, but would not likely adversely affect, the bald eagle, peregrine falcon, whooping crane, grizzly bear, and gray wolf. See appendix A.

Based on the above, this environmental restoration project would be in compliance with the Act. However, construction is not scheduled to begin until 2001 and only one area would be constructed each year between 2001 and 2004. If construction is not begun within 180 days of the date the above species list was issued, a new species list must be obtained and a review of the BA completed. If construction is implemented in accordance with the above schedule, a new species list and review of the BA would be required prior to each year of the proposed 4-year construction phase.

7.1.6 The NEPA

This EA has been prepared pursuant to requirements of the Act. No significant impacts have been identified at this time. If no significant impact is identified during the public review process, an EIS would not be required. If an EIS is not required, full compliance with NEPA would be achieved upon the signing of a Finding of No Significant Impact (FONSI).

7.1.7 Wild and Scenic Rivers Act

This segment of the Snake River is not included on the inventory of wild and scenic rivers. (National Wild and Scenic Rivers System, December 1992 and its 1997 updates, published by Department of the Interior and the Department of Agriculture, Forest Service.)

7.1.8 Migratory Bird Treaty Act

The environmental restoration work would be performed in such a manner that migratory birds or their habitat would not be harmed or harassed. The proposed work would be performed outside of the major nesting season for most birds. Bird species that nest later in the summer, such as the American goldfinch (*Carduelis tristis),* may be impacted by noise and activity associated with construction and gravel sorting. The proposed action does not involve the removal of mature trees that may be used for nesting by bird species protected by this act. Some brush and small trees would be damaged or removed during construction of side channels and pools. If there are no bald eagles nests found within 1 mile of the environmental restoration project area, work may begin earlier than August 15 after consultation with the USFWS. This consultation is necessary to ensure no other nesting migratory birds would be impacted by the construction activity.

7.2 EXECUTIVE ORDERS

7.2.1 Executive Order 11988, Floodplain Management, May 24, 1977

The use of structures such as eco fences, spur dikes, and anchored root wad logs for restoration purposes necessitates their construction within the 100-year flood profile. However, such environmental restoration measures would not directly or indirectly support development in the base floodplain. Most of the channel modifications would fall within the regulatory floodway as delineated by the Federal Emergency Management Agency in their May 4, 1989, Teton County Flood Insurance Study (FIS). The area is designated as a no-rise area, meaning that actions within or adjacent to the floodway should not result in a rise in the regulatory, 100-year flood water-surface profile.

To assist in assessing the potential for a reduction in the base floodplain, hydraulic modeling of the Snake River in each of the study areas was performed using HEC-2, a computer-based backwater model developed by the U.S. Army HEC. In Area 1, comparison of the profiles with and without the environmental restoration measures indicates that the environmental restoration project would result in lowering the water surface profile up to about 1 foot in the excavated areas. The environmental restoration measures in this area are not expected to result in a rise in the 100-year flood profile.

At Area 4, the proposed environmental restoration measures would lower the existing profile (1996) at or below the regulatory level for all areas within the environmental restoration area. Based on observed water surface profiles at Area 9, along with results of the hydraulic modeling, it does not appear the environmental restoration measures would result in any rise above the regulatory 100-year profile. For Area 10, the restored channel profiles would be below the 100-year profile.

The proposed action would not decrease the base floodplain or support development in the floodplain. Based on these findings, the environmental restoration project would be in compliance with the Order.

7.2.2. Executive Order 11990, Protection of Wetlands, May 24, 1977

The proposed action is intended to restore and protect riparian and wetland habitat. The proposed environmental restoration tools would be strategically placed to prevent erosion of riparian and wetland areas and to facilitate conditions suitable for wetland development. The proposed action would not support new construction in wetlands.

The contractor would coordinate with the Corps' biologist, representative for the (Jackson Hole) flood control project, and the landowner (in the field) to determine the optimum access routes and locations for structure placement to avoid (to the extent possible) impacts to existing wetlands. The proposed action would be in compliance with the Order.

7.3 STATE PERMITS

No permits are required from the State of Wyoming at this time. If, however, the State of Wyoming determines during their review of this EA that a permit is required, the local sponsor would take appropriate action to apply for and obtain the necessary permits prior to the start of construction.

7.4 ADDITIONAL REQUIREMENTS

A Temporary Gravel Extraction and Processing Permit must be obtained pursuant to Teton County Land Development Regulation. The local sponsor would apply for the permit through the Teton County Planning Department prior to the start of construction.

A permit must be obtained from the BLM prior to initiation of gravel removal from lands administered by that agency. The local sponsor would obtain the permit.

7.4.1 Noise Standards, 24 CFR 51 B

Noise would occur principally in association with truck transportation of materials and supplies, operation of excavation equipment, operation of equipment to screen cobbles, and operation of jackhammers for installation of root wad lag anchors.

Noise generated on site by the environmental restoration project would be experienced primarily by recreational users in the vicinity of construction areas. Most of the lands along the river segment are undeveloped. Public access to the project areas is primarily limited to levees extending upstream and downstream of Wilson Bridge near Area 9; therefore, most impacts of on-site noise will be concentrated around Area 9. Access to other areas of the project would occur by private landowners or by rafters or floaters. Rafters and floaters would be exposed to the increased noise levels when passing through the construction area. Truck traffic noise would be experienced by travelers on roadways being used for ingress and egress to active construction sites. Gravel removal and processing activities in the vicinity of Area 9 contribute to the existing background noise.

Increased noise levels would be restricted to daylight hours. Any increases in noise levels beyond existing background levels would be short-term.

7.4.2 The CEQ Memorandum, August 11, 1990, Analysis of Impacts of Prime or Unique Agricultural Lands in Implementing NEPA

No prime or unique farmland would be adversely impacted by construction. Access routes are not expected to cross farmlands. The environmental restoration project areas are all within the floodway. Many are bound by existing levees.

8.0 COORDINATION

This environmental restoration project has been coordinated with applicable agencies including USFWS, USFS, U.S. Environmental Protection Agency, BLM, Natural Resources Conservation Service, WGFD, Wyoming DEQ, Wyoming Division of Cultural Resources SHPO, and Wyoming Department of Transportation. Additionally, this EA has been distributed to interested members of the public for their review and comment.

9.0 LITERATURE CITED

Annear, T. 1989. *Snake River In-stream Flow Studies*. Administrative Report. WGFD, Fish Division, Cheyenne, Wyoming.

Bustard, D.R. and D.W. Narver. 1975b. *Aspects of the Winter Ecology of Juvenile Coho Salmon and Steelhead Trout*. Journal of the Fishery Research Board, Canada. 32:667-80.

Economic Development Council Web Site, Jackson Hole, Wyoming. 1997.

Erickson, J. 1980. *Give Them Gravel*. Wyoming Wildlife 44(5): 30-34.

American Institution of Fisheries Research Biologists. *Fish and Wildlife Relationships in Old-Growth Forests, Proceedings of a Symposium*. Juneau, Alaska.

Hickman, T. and R. Raleigh. February 1982. *Habitat Suitability Index Models: Cutthroat Trout*. Habitat Evaluation Procedures Group. U.S. Fish and Wildlife Service. Fort Collins, Colorado.

Jackson Hole Alliance, Carmindzend, Franz, personal communication, October 1998.

Jackson Hole Community Pathways, Young, Tim, personal communication, November 1998.

Kiefling, J.W. 1978. *Studies on the Ecology of the Snake River Cutthroat Trout*. Fisheries Technical Bulletin No. 3. Federal Aid Report F-37-R. WGFD, Cheyenne, Wyoming.

Kroger, R.L., 1967. *A Study of the Classification and Ecology of the Aquatic Invertebrates in the Snake River, Grand Teton National Park*. M.S. thesis. University of Wyoming, Laramie, Wyoming.

Public Law 99-662, Water Resources Development Act of 1986.

U.S. Army Corps of Engineers, Walla Walla District, *Jackson Hole Flood Protection: Levee Access Improvements, Draft Environmental Assessment*, 1994.

____. Jackson Hole, Wyoming Environmental Restoration, Project Study Plan, July 1996.

____. Jackson Hole, Wyoming Flood Protection Project, Final O&M Decision and Environmental Impact Statement, 1990.

U.S. Bureau of the Census 1989.

USFWS, P. Deibert, personal communication, July 1998.

___ . Bridger-Teton National Forest, Jackson, Wyoming, F. Kingwell, personal communication, March 19, 1989.

___ . Refuge Manager, Jackson, Wyoming, Hedrick, M., August 27, 1992, personal communication/Jackson Hole Flood Protection, Levee Access Improvements, Draft Environmental Assessment, November 1994.

Wyoming DEQ, Cheyenne, Wyoming, B. Daily, personal communication, April 7, 1993.

___ . Lander, Wyoming, L. Gribovicz, personal communication, September 16, 1998.

Wyoming State Land Farm Loan Office, Cheyenne, Wyoming, D. Force, personal communication, August 31, 1992.

10.0 REFERENCES

American Ornithologists' Union, 1983. *A.O.U. Checklist of North American Birds*.

Binns, N.A., and F.M. Eiserman. 1979. *Quantification of Fluvial Trout Habitat in Wyoming*. Transactions of the American Fisheries Society. 108:215-228.

Bisson, P.A., and J.R. Sedell. 1984. *Salmonid Populations in Streams in Clearcut vs. Old-growth Forests of Western Washington*. pp. 121-129 in: Meehan, W.R., T.R. Merrell, Jr., and T.A. Hanley (eds). Fish and wildlife relationships in old-growth forests, Proceedings of a symposium. Juneau, Alaska. American Institution of Fisheries Research Biologists.

Bisson, P.A., J.L. Nielsen, P.A. Pelmason, and L.E. Grove. 1981. *A System of Naming Habitat Types in Small Streams, with Examples of Habitat Utilization by Salmonids During Low Streamflows*. pp. 62-74 in: Armontrout, N.B. (ed). Acquisition and Utilization of Aquatic Habitat Inventory Information, Proceedings of a symposium. Portland, Oregon.

Bisson, P.A., K. Sullivan, and J.L. Nielsen. 1988. *Channel Hydraulics, Habitat Use, and Body Form of Juvenile Coho Salmon, Steelhead, and Cutthroat Trout in Streams.* Transactions of the American Fishery Society. 117:262-273.

Bustard, D.R., and D.W. Narver. 1975a. *Preferences of Juvenile Coho Salmon and Cutthroat Trout Relative to Simulated Alteration of Winter Habitat*. Journal of the Fishery Research Board, Canada. 32:681-87.

Clark and Stromberg. 1987. *Mammals of Wyoming*, University of Kansas Museum of Natural History.

Frayley, J.J. and P.J. Graham. 1981. *Physical Habitat, Geologies, Bedrock Types and Trout Densities in Tributaries of the Flathead River Drainage, Montana*. pp. 178-190 in: Armontrout, N.B. (ed). Acquisition and utilization of aquatic habitat inventory information, Proceedings of a symposium. Portland, Oregon.

House, R.A., and P.L. Boehne. 1986. *Effects of Instream Structures on Salmonid Habitat and Populations in Tobe Creek, Oregon*. North American Journal of Fishery Management. 6(1):38-46.

Lestelle, L.C. and C.J. Cederholm. 1984. *Short-term Effects of Organic Debris Removal on Resident Cutthroat Trout*. pp. 131-40. in: Meehan, W.R., T.R. Merrell, Jr., and T.A. Hanley (eds). Marti and Marks, 1987. Medium-Sized Owls from Proceedings of the Western Raptor Management Symposium and Workshop.

Marti and Marks. 1987. *Medium-Sized Owls,* Proceedings of the Western Raptor Management Symposium and Workshop.

Murphy, M.L., K.V. Koski, J. Heifetz, S.W. Johnson, D. Kirchhofer, and J.F. Thedinga. 1984*. Role of Large Organic Debris as Winter Habitat for Juvenile Salmonids in Alaska Streams*. pp. 251-262 in. Western Proceedings, 64th Annual Conference of the Western Association of Fish and Wildlife Agencies. Victoria, B.C.

Department of the Interior and the Department of Agriculture, Forest Service. *National Wild and Scenic River System*, December 1992 and 1997 updates.

Phillips, Clynn, PhD. 1987 *Jackson Hole Fishery Resources, Economic Implications of Management Alternatives*.

Robbins, Brum and Zim,. 1983. *Birds of North American*. Golden Press

Swales, S., R.B. Lauzier, and C.D. Levings. 1986. *Winter Habitat Preferences of Juvenile Salmonids in Two Interior Rivers in British Columbia, Canada*. Canadian Journal of Zoology. 64(7):1506-1514.

U.S. Army Corps of Engineers, Walla Walla District. June 1993. *Jackson Hole, Wyoming, Environmental Restoration, Reconnaissance Report*.

___ . December 1989. Draft Environmental Assessment: *Jackson Hole, Wyoming, Snake - Gros Ventre Rivers, Debris Clearance Project*.

USFWS. 1988. Preliminary Biological Evaluation: *Wyoming, Snake River and Spring Creeks Levees.* Prepared for the U.S. Army Corps of Engineers, Walla Walla District. U.S. Department of the Interior, Fish and Wildlife Service. Boise, Idaho.

___ . April 1990. *Fish and Wildlife CAR for the Jackson Hole Snake River Flood Protection/Levee Maintenance Project*. Teton County, Wyoming.

Whitaker, Chanticleer Press, 1980. *The Audubon Society Field Guide to North American Mammals*.